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Craftsmanship and Science.

IT is well known that in Sir William Bragg the Governors of the Royal Institution found a most worthy successor to the distinguished men of science who had occupied the chair of Davy and Faraday—one who, like his forerunners, can expound the wonders of science in terms that the ordinary man or woman can understand, and with a flowing eloquence which holds his hearers as though spell-bound; as president of the British Association, Sir William is equally at home; and by his masterly review of the relationship between science and industry, he has shed new lustre on that office. To the views which he expressed we cordially adhere: indeed, so far as we have touched upon the questions which he dealt with, we have endeavoured, though without his craftsmanship, to inculcate the same precepts. Of the immense importance of scientific research ("pure," as well as "applied") to industrial progress we have often written with all the emphasis at our command, and we only regret that we are unable to reproduce in full the able arguments which Sir William marshalls in support of his claim that "craft is based on science," and of the thesis that "the improvement of craftsmanship depends in large part on the absorption and adaptation of scientific discovery."

An interesting and important point on which he lays the greatest stress is that scientific knowledge and experience, if they are to be fully utilised, must be in direct practical contact with the problem that is to be solved. He gave a most apt instance illustrating the point, but most of us can recall examples that will serve. It is impossible to work efficiently in watertight compartments—the draughtsman who is allowed, and encouraged, to visit the "shops" and see for himself what is needed and what is being done, is vastly more efficient than the one who is confined to the drawing office. This principle is admirably illustrated in the research laboratories maintained by our leading electrical manufacturers, which are in the closest touch with the factories and are constantly consulted with regard to difficulties encountered or improvements con-

templated in the course of manufacture. At its Wembley Laboratories, for instance, the General Electric Co., Ltd., installed complete lamp-making plant on a small scale, similar to that in commercial operation at its factories, to enable the research workers to reproduce factory conditions when necessary, or, on the other hand, to try out new developments on a practical scale with the greatest facility. Sir William referred with approval to the huge sums expended by American companies on research, pointing out that the financial return justified that policy—as we have often urged; it must be admitted that in this country the amount expended on research is comparatively small, but it is consoling to think that the value of research is steadily gaining recognition, and that in spite of the restricted funds at their disposal, our investigators have achieved remarkable results in many branches of industry. Sir William claims—and there is abundance of evidence to justify his statement—that in this country the means to improve the processes of craftsmanship exist "even to a remarkable degree"; we have the craftsmen, keen and intelligent, and we have the research workers who can supply to craftsmanship "the scientific knowledge which is one of its essentials." It only remains to bring these two classes together in co-operation, providing the means (including adequate remuneration) for the researchers to do their part, and keeping on the alert to adopt new ideas and establish new industries.

Coal Prices and the Electric Fire.

JUDGING from apparently inspired notices that have been appearing in the newspapers during the last few weeks, the coal trade intends to make the domestic public pay more for its commodity this winter than it paid last year. We hope that vendors of electric heating appliances will quickly turn to account the advantageous opportunity thus presented. If coal supplies are short, or if the price causes dissatisfaction, electric and gas fires—even oil stoves—are in greater demand. The first advances have taken place just as the early mornings and late evenings are becoming a little chilly; it is now that the electric fire proves of greatest value to large numbers of consumers who cannot afford to keep it going for whole day service in the winter. It gives just that degree of dining-room warmth needed for the family breakfast-time before the various members of the household set out upon the day's duties, and it renders similar service in the evenings on their return, or at listening time, and at the last hour or two before "turning-in." Local electrical contractors and dealers should make full use of this talking-point just now. The modern flat or smaller type of house does not afford accommodation for storing tons of coal of different kinds; it is the occupiers of the older types of houses with large cellars, who can avail themselves of lowest summer prices. The electric fire generally costs the same per unit in winter as in summer, and with it there are no grates to clean, no cinders to get rid of, and no early morning fire-kindling to give one the shivers at the meal which precedes the work of the day. Later in the year, according to our custom, we shall deal fully with all the interesting types of electric heating apparatus on the market. Manufacturers, however, are already placing their products before the trade, and contractors and dealers should lay in their requirements at once if they have not already ordered them.

The G.E.C. and British Control.

A FEW months ago some attention was being directed to the purchase of British electrical securities on behalf of foreign interests. While such activity was, and is to be, welcomed to some extent, fears were expressed in some quarters lest such purchasing might be carried to a point where the control of undertakings and producing companies would be transferred to holders outside the United Kingdom with results possibly, even probably, detrimental to the volume of British production. In addition to some reports which were confirmed, there were others which gained currency occasionally on the Stock Exchange, but which required qualification and explanation. For instance, some of the shares of the General Electric Company, Limited, of London and Witton, were purchased by American buyers, and transactions in the shares in New York were reported. Rumours followed, because other movements were also in the public mind. Sir Hugo Hirst, in addressing the annual meeting in July, referred to the subject, and stated that while in the ordinary course of things it did not matter one way or the other who were G.E.C. shareholders, it was the intention of the board to watch closely any movement in the direction above mentioned, because it might cause embarrassment some day if it were found that too big a proportion of their shares were in non-British hands. He spoke in this way because the business was a national one, not because of any objections of a personal character, and hinted that it might be necessary to introduce measures which would keep such a movement in check within certain proportions, thus ensuring that the control should at all times be in the hands of British subjects. The Company now announces its intention to take definite steps to carry this idea into effect by making certain alterations and additions to the Articles of Association. These have been approved by the Stock Exchange Committee and are to be submitted to a meeting of shareholders to-day (Friday). We refer to the changes in our "City Notes," where the definition of "foreigner" will be found, together with a note of the measures which can be employed to deprive "foreign" holders of voting rights. The decision, which we believe will be favourably regarded by shareholders, will also, we feel, be welcomed by the industry and will increase the popularity of the securities with the British public. We do not require to have very long memories to recall what searching investigations some of us had to make, and what unlooked-for revelations took place regarding share ownership and company control, when we were required to "carry on" in spite of the Trading with the Enemy Acts of thirteen or fourteen years ago.

Royalties on Electricity in Transit.

A NOVEL claim was put forward by a landowner at a Ministry of Transport wayleave inquiry last week—namely, that he was entitled to a royalty for the passage of electricity over his land. Such royalties are paid, as the claimant pointed out, for the transport of coal over private property. The Inspector holding the inquiry refused to accept the analogy, though he made a note of the point.

As the law stands, authorised undertakers are empowered to place electric lines across any land not covered by buildings or used as a garden or pleasure ground, subject to appeal to the Minister of Transport, whose decision appears to be final. The owners of such lines are already sufficiently worried over the cost of wayleaves for poles, to say nothing of royalties on electricity in transit—which would probably put an end to electric power transmission except along the public roads. However, there is no risk of such an outcome—the Central Electricity Board itself would have to "down tools" if royalties of this kind could be enforced, and Parliament would speedily come to the rescue. That the carriage of commodities such as coal over private land, involving the use of the surface of the soil, equivalent to a tenancy, should be paid for may be conceded, but that the passage of electricity—or gas, or water, or light, for that matter—under or over private property, without affecting the use or enjoyment of that property in any way whatever, should be the subject of a tax is unthinkable. "Something for nothing" is not good economics.

Testing Supervolt Cables in the Factory.

A description of the modern high-voltage electric power cable testing plant installed at the North Woolwich works of Standard Telephones & Cables, Ltd.

THE new cable-testing plant laid down by Standard Telephones and Cables, Ltd., was designed and installed with the object of providing complete modern facilities for all the various tests which may be required to be applied in the factory to power cables intended to operate at 20,000 volts and upwards. Many of them are common to low- and high-voltage cables alike, and are carried out by means of well-known methods which have been long established; no description need therefore be given of such tests as those for insulation resistance, electrostatic capacity, conductor resistance, or bending. The plant described is of a kind which is peculiar to tests on finished high-voltage cables, and was in many details specially designed for the work, and thus incorporates certain features which are novel.

Tests of a special nature which are likely to be called for are as follows:—(1) high-pressure test; (2) load test at full working voltage; (3) thermal resistance; (4) dielectric loss and power factor; (5) breakdown test; and (6) wave form in special cases.

The whole of the plant and apparatus for conducting factory tests on all types of telephone cable, power cable, &c., is accommodated in one building, which was newly erected in such a manner and position that cable as it is manufactured can most conveniently and expeditiously be brought into the testing area and then passed out for shipment. The new building is an extension at one end of the existing shops, and the general view reproduced in fig 3, p. 385, will demonstrate how the various parts of the plant are placed in relation to one another. In the foreground is a tank used for immersing telephone cables in water; behind it is an enclosure where three tanks are located for tesing power cable up to 11,000 volts in water at pressures up to a maximum of about 60,000 volts. On the ground floor at the right is an area where routine tests on telephone cables are made. The control of both telephone- and power-cable tests is centred in a series of offices in a gallery which runs along the whole of the building on the right. The supply of power for testing power cables of standard voltages up to 11,000 volts is received through underground cables from a 120-kV single-phase testing transformer placed on the opposite side of the gallery. Towards the end of the shop extension can be seen the high-voltage transformers and their associated gear for supervolt cable testing, all of which is controlled from the offices in the gallery on the right.

High-pressure Test.—The plant for high-pressure testing exercises a most important influence on the determination of the general plan of the whole apparatus. The layout of the transformers is illustrated in fig. 4, each being designed for 150,000 volts, 100 kVA. They are oil-immersed, self-cooled, and of a special core type construction developed by Messrs. Ferranti, Ltd., for high-voltage testing. The cores are mounted horizontally in their tanks, so simplifying the problem of bringing out the end of the h.p. winding and reducing the overall height. The whole of each transformer is carried on rollers, on rails forming part of the tank; it is not, therefore, necessary to use the crane to remove the transformer for inspection, but simply to unbolt the end-plate and disconnect the terminals after the oil has been run off, when the transformer can be rolled out without disturbing the h.p. terminal. Choke coils are incorporated in the h.p. terminal bushing to reduce the risk of voltage surges when a flashover or breakdown occurs on the cable under test. Connections to cables under pressure test are made through liquid resistances for the same reason also, the resistances being enclosed in bakelite tubes of sufficient length to prevent flashover. One of them may be seen suspended from the centre bus-bar in fig. 4.

For three-phase tests the h.p. windings are connected in star to give a maximum voltage of 260,000 volts, three-phase, and for single-phase tests one or more transformers may be used as follows: the h.p. winding of the centre transformer is insulated for 300,000 volts to earth, so that when it is connected in series with one of the other two transformers, it is capable of carrying out tests up to a maximum of 300,000 volts, single-phase. If this voltage requires to be exceeded, the third transformer may be connected in series with the earthed terminal of the centre transformer, and by keeping earthed the one end of the centre transformer, a maximum voltage of 450,000 volts (single-phase) is obtained, one terminal of the circuit being 300,000 volts above earth and the other end 150,000 volts below earth. For a test of this nature it is, of course, necessary to have the lead sheath of the sample under test completely insulated from earth.

Pressure tests on three-core belted cables are usually carried out as three-phase tests, while in the case of equipotential-sheath type three-core cables the test may be either three-phase or single-phase, as is most expedient, the three cores being bunched together for a single-phase test. When long lengths of cable are under test and the capacity current to the sample would be too great for a single transformer, two or three transformers are coupled in parallel in order to provide the requisite power.

Connection to cables under test by means of bare or insulated wire is always troublesome and sometimes dangerous, hence tubular bus-bars carried on porcelain pillars have been provided between the transformers and the points where the cable may be tested.

Supply and Control for Transformers.—Fig. 5 shows the motor-generator set which supplies current at 3,000 volts at the required frequency, having an output of 300 kVA and being driven by a directly coupled motor. The alternator was specially designed to give an approximately pure sine wave, even on a capacity load, and oscillograph records obtained when pressure tests were in progress on cable lengths have confirmed that this aim has been achieved.

A.c. at 3,000 volts is supplied to three single-phase induction regulators, illustrated in fig. 6, the three phases of which are controlled either independently or collectively as required by means of push-button switches in the main control room by the medium of a small electric motor. By this means the voltage applied to the l.p. side of the testing transformers may be varied from 0 to 6,000 volts, and each time the main switch is opened after a test has been completed the setting of the induction regulator automatically returns to the zero-voltage position. Further, interlocks are provided so that the main switch can be closed only when the field rheostat of the alternator is at the minimum-voltage position. This rheostat provides an alternative method of voltage variation by strengthening, or weakening, the field of the exciter set seen in

the foreground of fig. 5. A very wide range of frequency can be obtained by altering the field strength of the d.c. motor driving the alternator. It is thus possible to carry out a test at any frequency from 25 to 55 cycles per second. The ratings of the testing transformer mentioned above are, of course, only available at the standard testing frequency of 50 cycles per second, the maximum pressure being reduced in direct proportion at lower frequencies.

Fig. 1.—A Million-volt Arc, 9 ft 6 in. long.

Pressure Test on h.p. Transformers.—As indicated above, the h.p. transformers and associated gear were manufactured by Messrs. Ferranti, Ltd., and were subjected to the most stringent tests before being installed. It is interesting to note that during their progress the first million-volt arc produced in this country was obtained. Fig. 1 shows in the foreground the transformer insulated for 300,000 volts above earth on the high-pressure terminal during the actual test at a million volts. This transformer is the one seen in the centre in fig. 4. The length of the arc, a separate enlarged photograph of which is reproduced in fig. 2, was 9 ft. 6 in., and the arc was maintained for some seconds at a pressure calculated to have been 1,012,000 volts r.m.s. until the discharge broke down the insulation of certain of the l.p. equipment, thus terminating the test. We are indebted to Messrs. Ferranti for the loan of the two photographs mentioned above, which were taken during the course of the pressure tests at their works.

Measurement of Voltage.—Some difficulty was experienced in deciding on a satisfactory means of measuring the voltage to which the h.p. transformers are subjected. Measurements on the l.p. winding of such transformers are not trustworthy as an indication of the voltage on the h.p. winding, since the ratio of transformation is liable to change when a load of high electrostatic capacity varies. A voltmeter is, in fact, fitted on the control board to indicate the pressure applied to the transformers, but the difficulty was overcome by having specially constructed a direct-reading voltmeter of the Everett-Edgcumbe type, illustrated on the extreme right of fig. 4. This voltmeter has four ranges, on the highest of which it is direct-reading up to 300,000 volts. The reading can be calibrated by means of the 10-in. sphere spark-gap seen beneath the centre bus-bar in the spark-gap pit in fig. 4.

Another method of correct voltage measurement when the voltage does not exceed 75,000 V, for instance, in the case of dielectric-loss measurements, is to use a non-inductive resistance as a potential divider and measure the current through this resistance accurately by means of a high-grade ammeter.

Breakdown Test.—It is still the practice of purchasers of cable to specify that a short sample of the cable must be tested until breakdown occurs, although the value of such a test has been called into question on many a recent occasion. On the one hand there is no doubt, of course, that a routine pressure test on every length of cable is essential in order to detect any weak spots, or mechanical faults, for instance, which may be present. On the other hand, the suggestion that by measuring the short-period breakdown of a sample its probable life in service can be deduced, is extremely doubtful, taking into consideration the enormous variations in the predicted life of a cable (calculated according to any accepted law for this particular class of cable) produced by a very slight change in the law. It therefore appears that time-voltage tests are at present of no value as an indication of the probable life of a cable, and breakdown tests are therefore of little value to purchasers of cable as a criterion for the acceptance of such cable. However, long-period tests at excess pressures are useful to the manufacturers themselves in studying the problem, and for this reason and also to meet the requirements of those customers who continue to specify breakdown tests, facilities have had to be provided for carrying out breakdown tests with the plant described up to a maximum of 260,000 volts, three-phase, or 450,000 volts, single-phase.

Load Tests, Thermal Resistance, and Repeated Heat-Cycle Tests.—The importance of load tests on high-voltage cables is now fully realised, and there are therefore several tests which necessitate the provision of plant to heat up the cable by circulating current through the cores. In the first place, the difference in temperature between the copper and the lead, when steady conditions are reached, enables the thermal conductance of the cable to be calculated, thereby enabling checks to be made concerning load-current guarantees. In the second place, the variation of dielectric loss and power factor with the temperature of the conductor must often be measured. In the third place, it is now generally agreed that by comparing the power-factor characteristics after a cable has cooled following a heat run with the power factor obtained at the same voltages before the heat run took place, a very valuable guide is obtained as to whether a supervolt cable will be satisfactory in service under conditions of full-load current and voltage; further mention of this point will be made later.

Fig. 2.—Enlarged View of the Million-volt Arc.

The plant provided for load tests consists of three single-phase 25-kVA transformers as illustrated in fig. 11, which will supply 400 amperes three-phase at 62.5 volts, or 200 amperes three-phase at 125 volts,

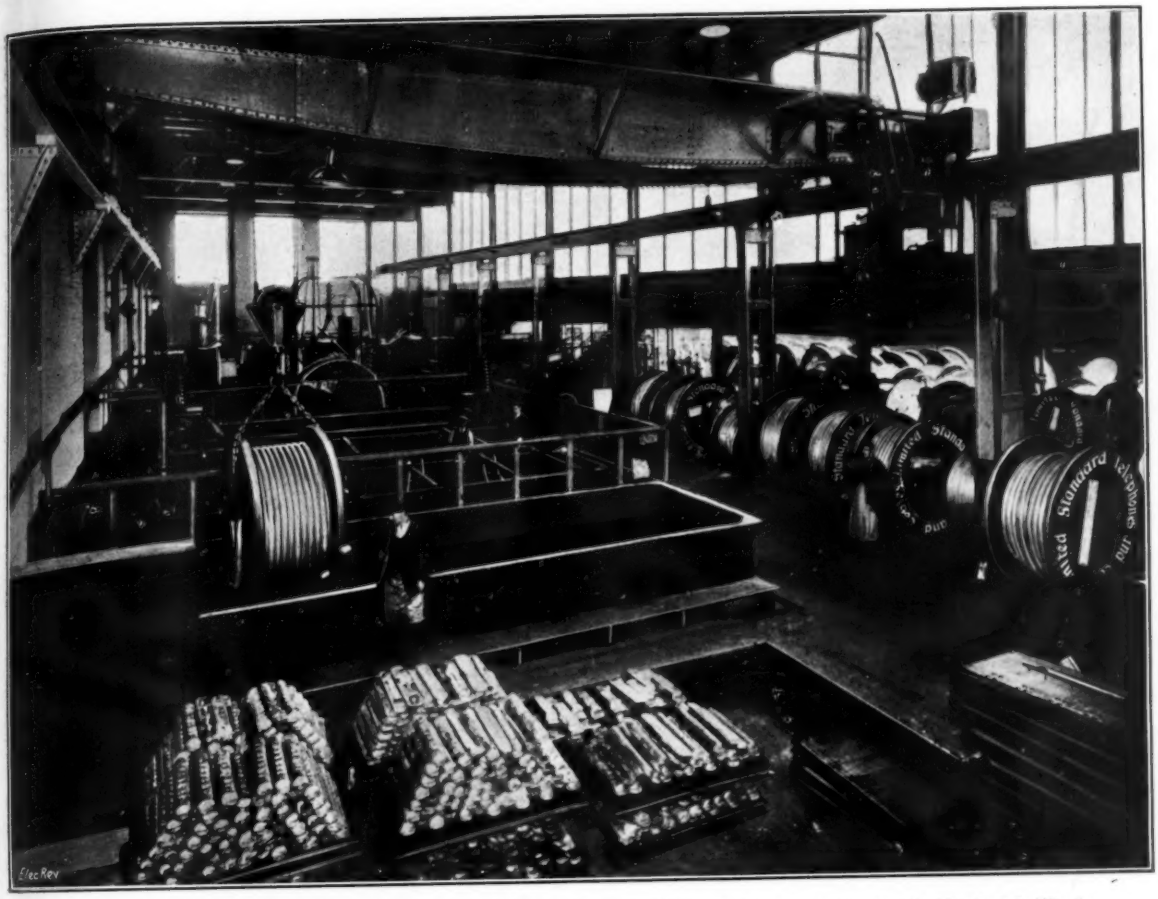


Fig. 3.—General View of Testing Department of Standard Telephones & Cables, Ltd., North Woolwich Works.

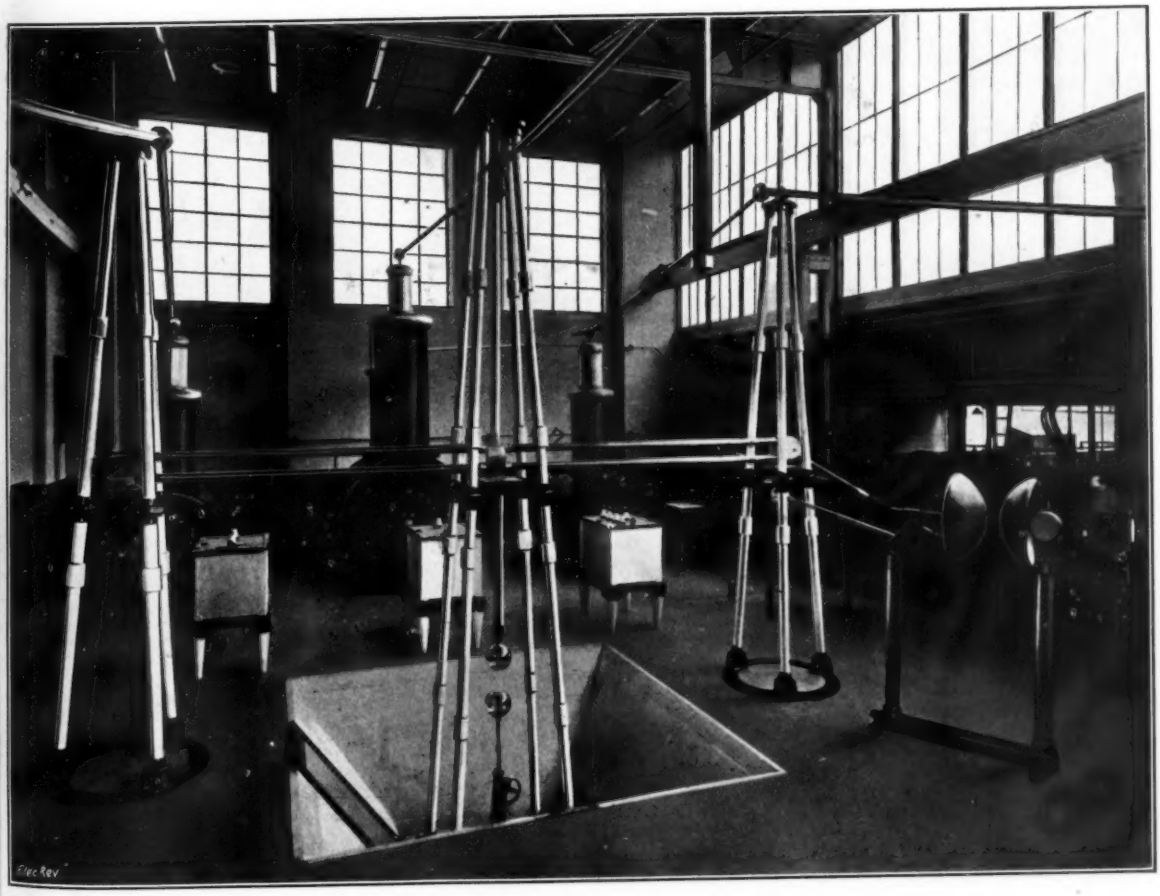


Fig. 4.—Ferranti 150-kV, 100-kVA Testing Transformers.

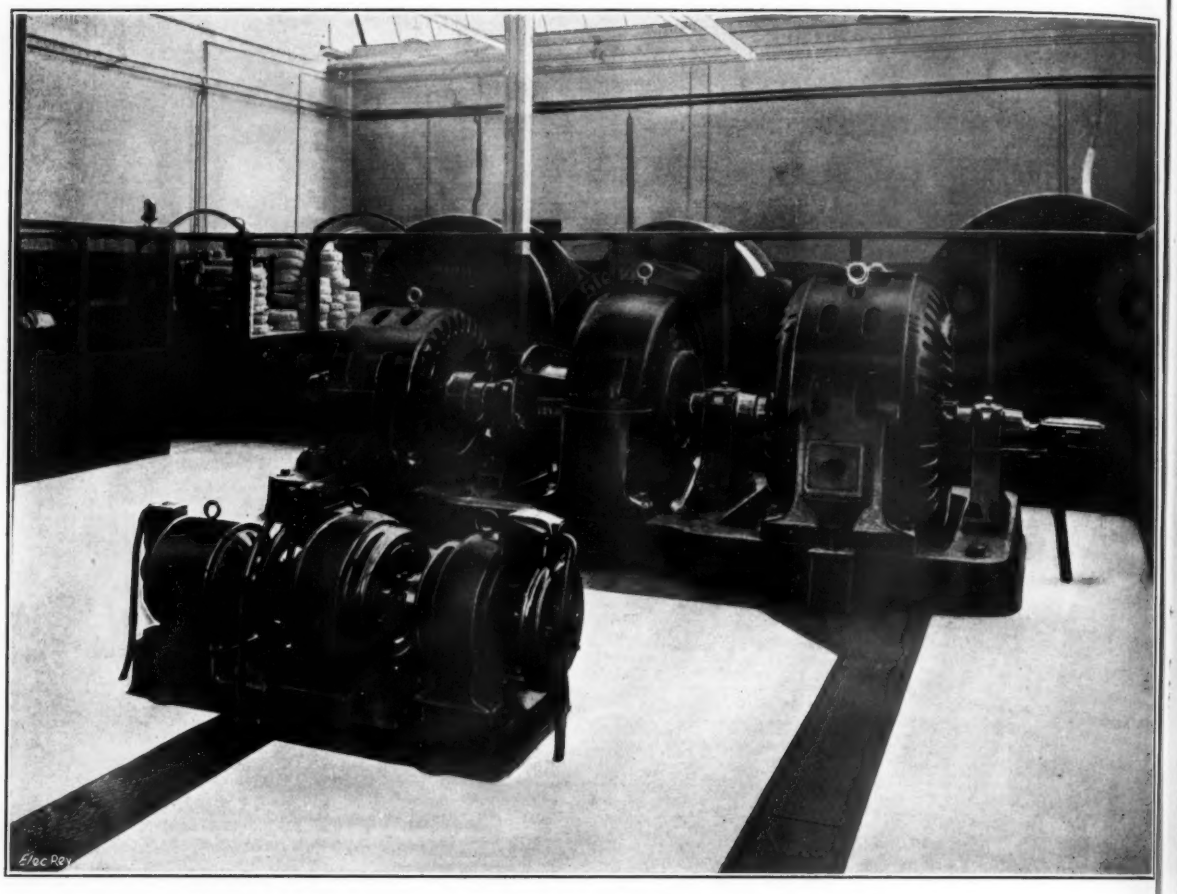


Fig. 5.—Variable-frequency 3,000-V, 300-kVA Motor-generator, and Exciter Set.

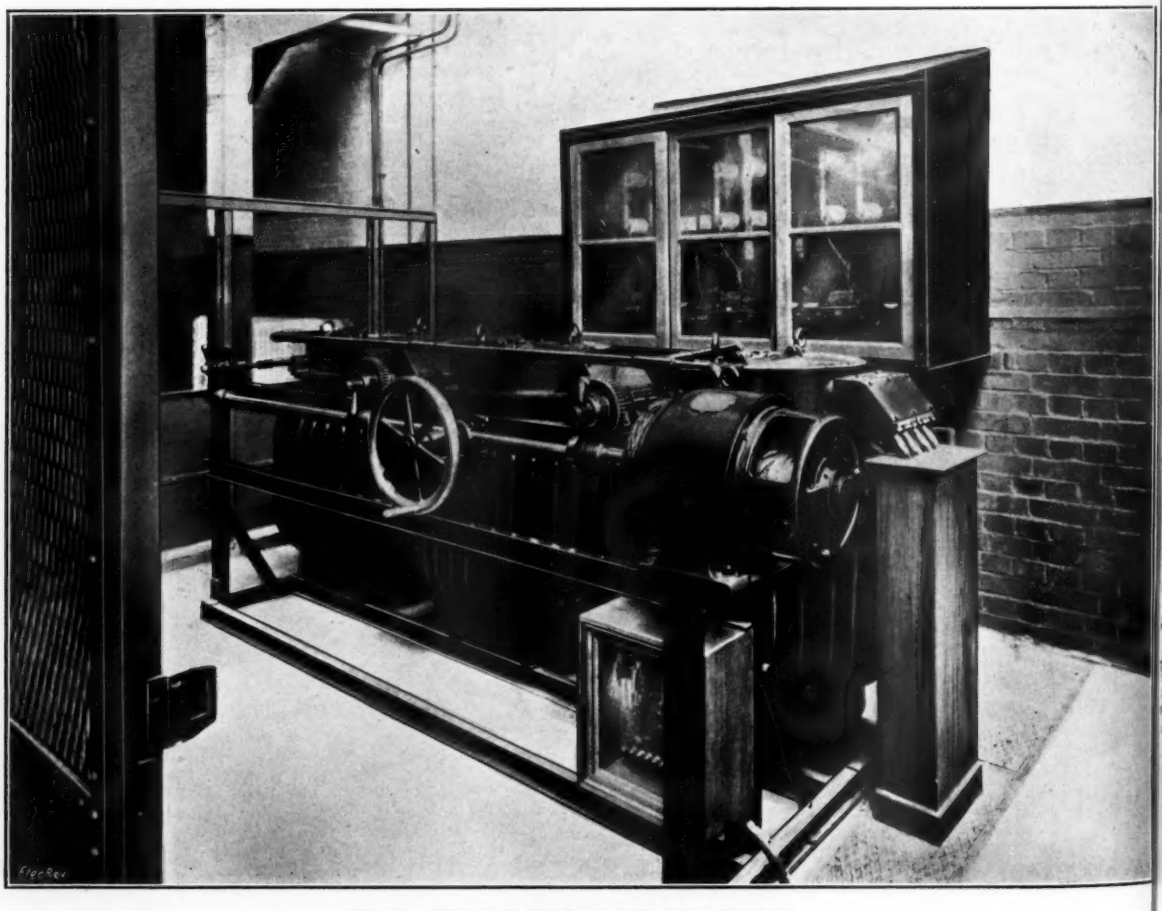


Fig. 6.—Three Single-phase Induction Regulators.

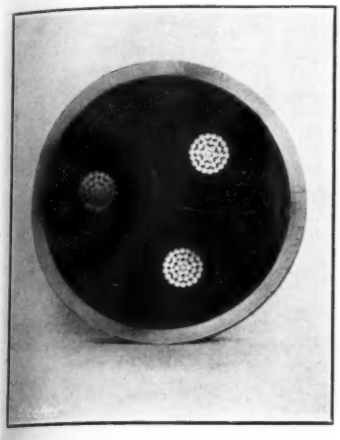


Fig. 7.—Cross Section of 66-kV Cable.

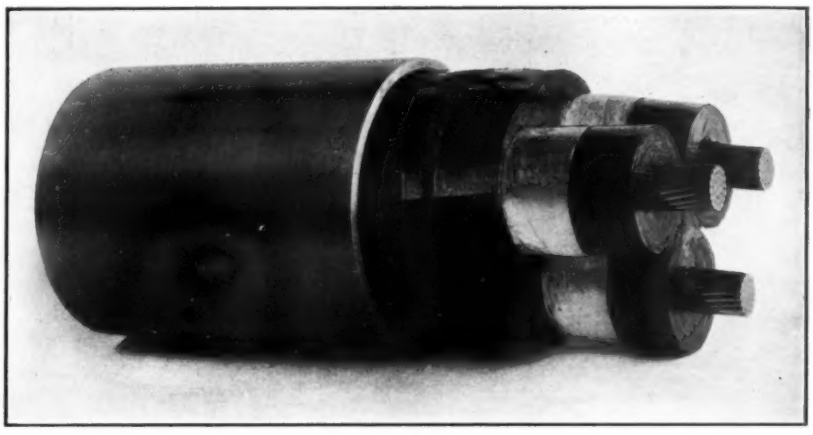


Fig. 8.—Telescoped Sample of 66-kV Cable.

Fig. 9.—Control Desk on Gallery.

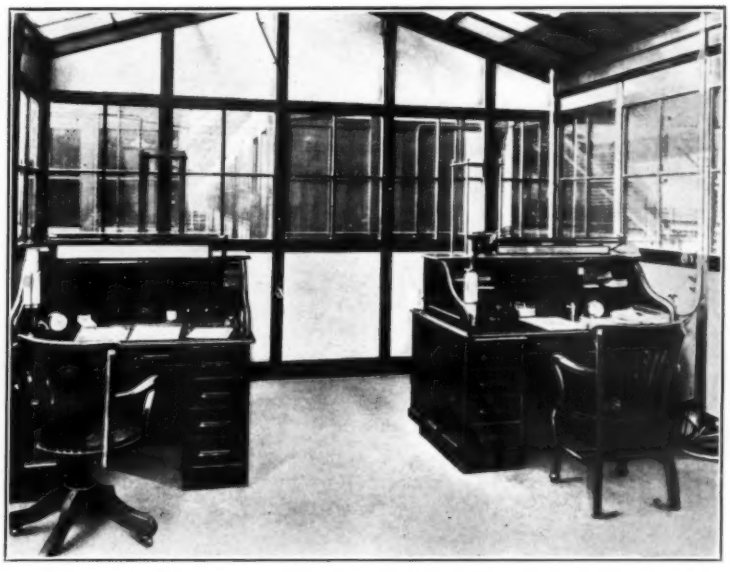


Fig. 10.—Test Desks for Capacity and Insulation Resistance Measurement.

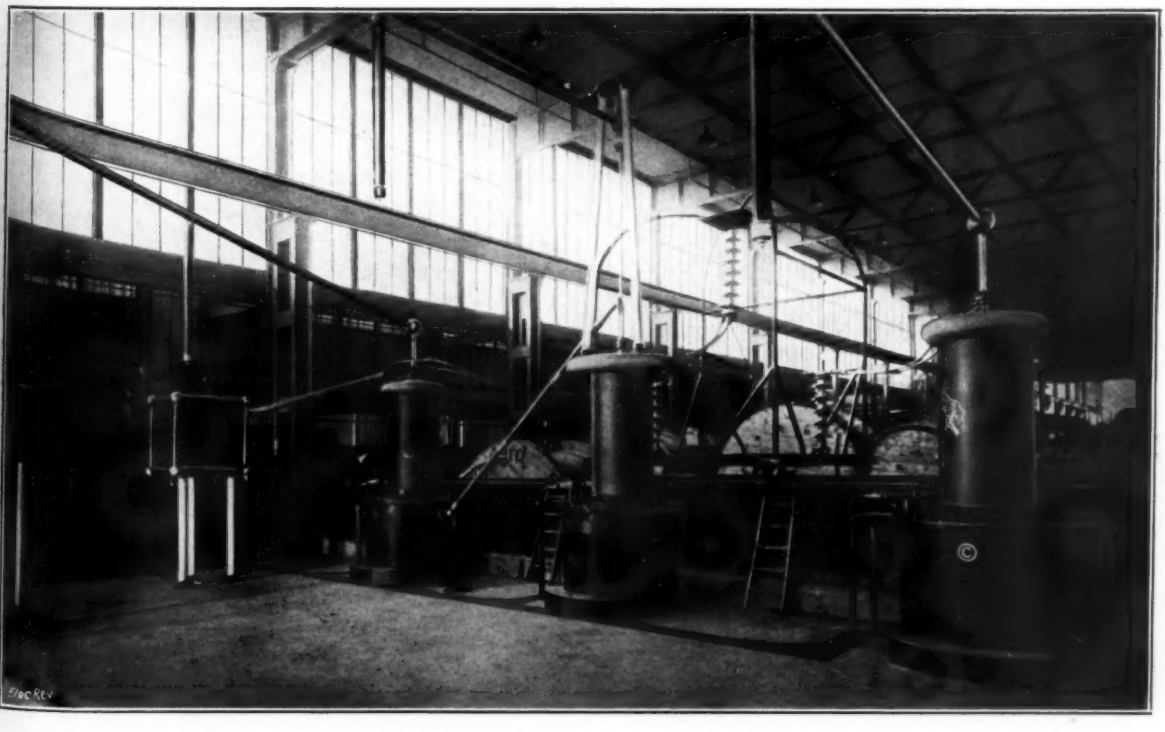


Fig. 11.—Single-phase, 25-kVA Load-test Transformers at N. Woolwich Works of Standard Telephones & Cables, Ltd.

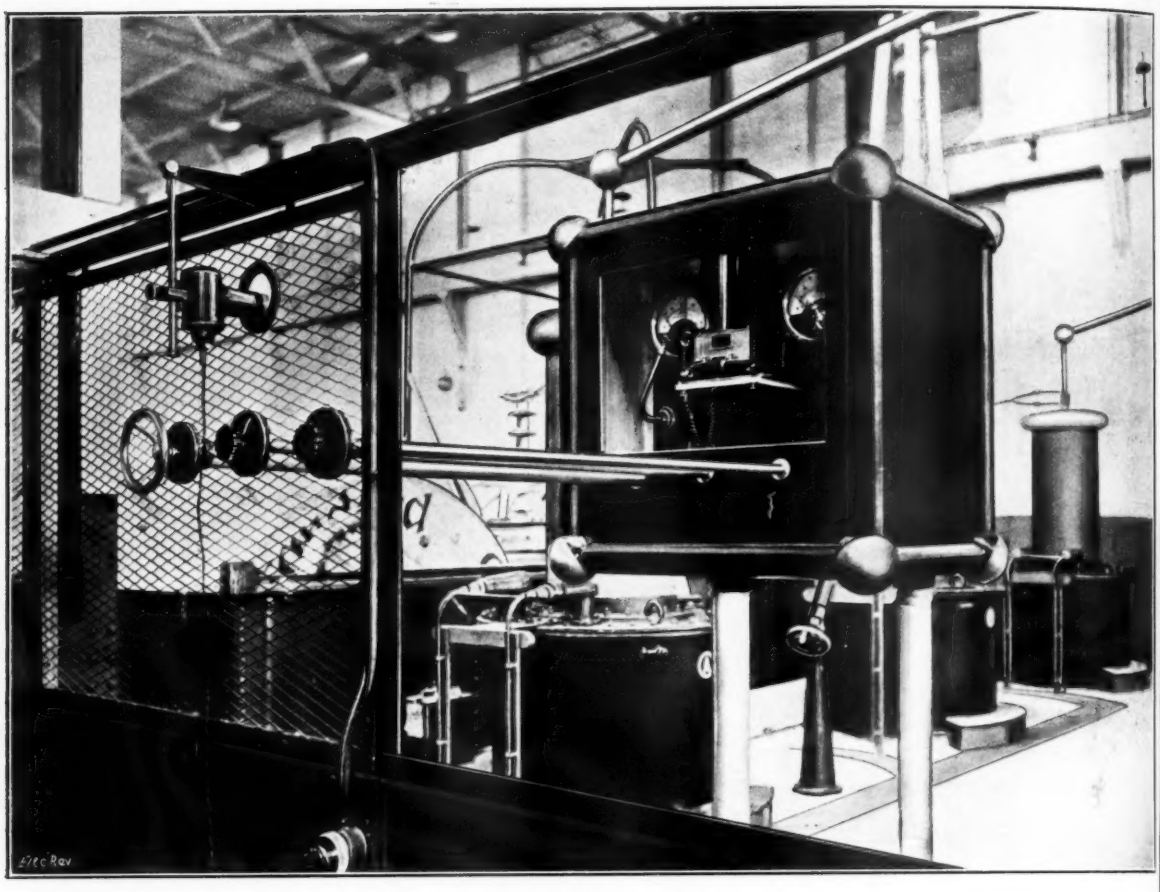


Fig. 12.—Panel for Core-resistance Measurement.

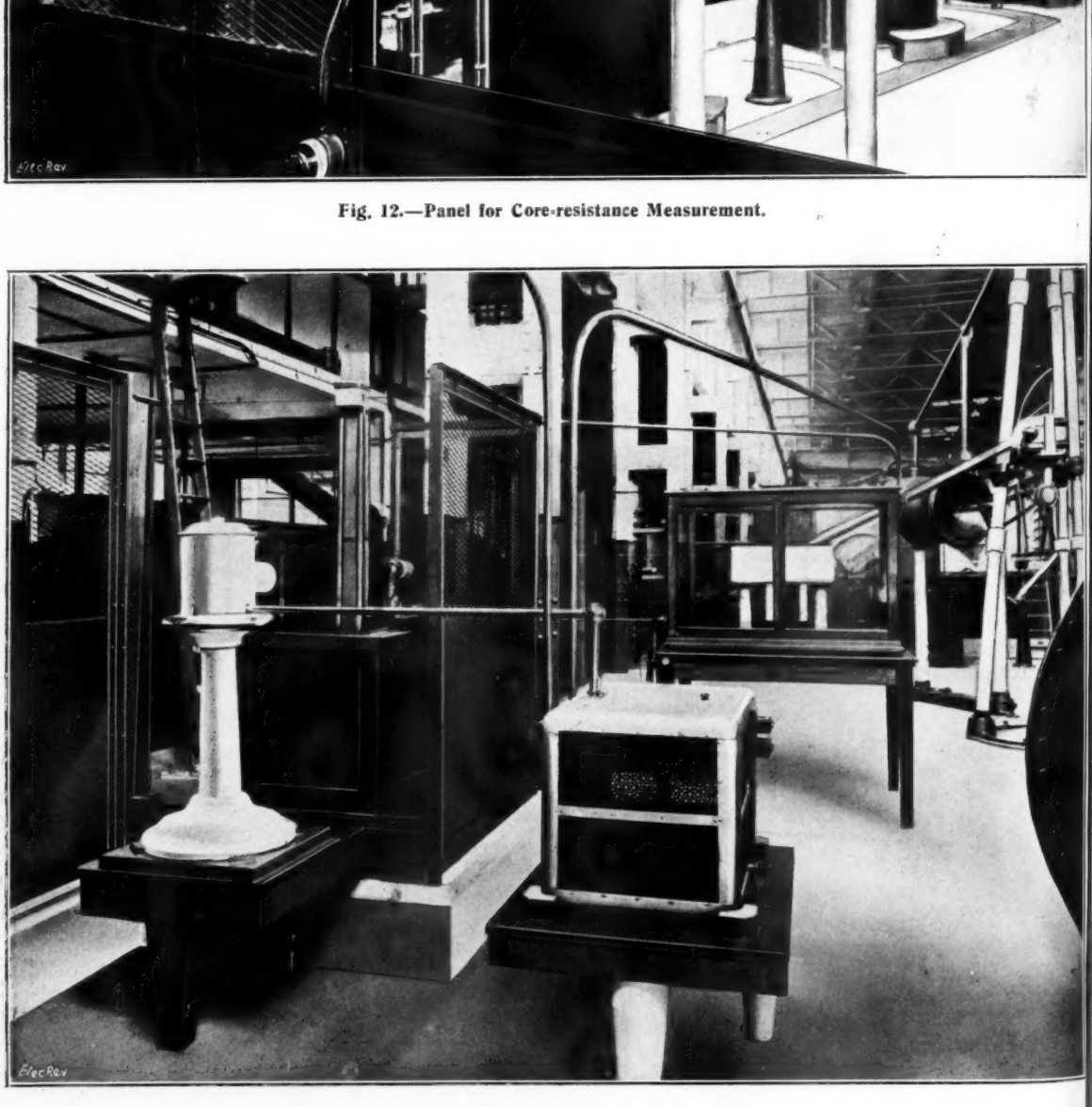


Fig. 13.—Wattmeter in Screened Case, and Oscillograph.

the whole of the secondary windings being insulated to withstand the full voltage to earth of the pressure transformers, *viz.*, 150,000 volts. By this means it is possible to test a cable under actual full-load conditions, that is, with the full-load current passing through the cores and the full working voltage imposed on the dielectric. If it is necessary to do so, the three load transformers may be connected in parallel to give a maximum of 1,200 amperes at 62.5 volts, or connected in series to give 200 amperes at 375 volts, by this means covering the whole probable range of conductor section, or cable length.

The transformers are energised by a 75-kVA, 400-volt alternator mounted on the same shaft as the alternator

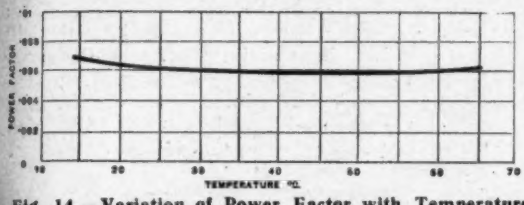


Fig. 14.—Variation of Power Factor with Temperature, 3-core, 33-kV, "H"-type Cable.

which feeds the h.p. transformers (fig. 5), and the current is varied by rheostat control of the alternator field.

Resistance-Measuring Switchboard.—The method of measuring the conductor temperature consists of comparing the resistance of the conductor when hot with its value previously obtained when cold, and this can be done without interrupting the load current or voltage by means of a special h.p. switchboard which has been designed for the purpose. The same method was employed on l.p. circuits in the buried cable research carried out by the British Electrical and Allied Industries Research Association, but the novelty of the new method is that the whole of the apparatus works at the full pressure to earth used in the tests. It is interesting to note that this method has given complete satisfaction and is capable of a high degree of accuracy.

By means of a well-insulated switch (see fig. 12, p 388) a 0.01-ohm shunt and a 2-volt traction-type battery can be thrown into circuit with one core, and the shunt and the battery are capable of carrying the full load of 400 amperes a.c. for short periods. A small direct current can thus be superimposed on the alternating load current, and the relative potential drop across the cable core and across the shunt can be measured by a galvanometer which is sensitive to direct-current voltage only. On the same panel are mounted an a.c. ammeter to indicate the full-load current, and an a.c. voltmeter to indicate the impedance voltage drop in the core. As stated above, the whole panel is insulated on porcelain legs for 150,000 volts to earth, and by means of a metallic screen connected to the supply bus-bar all errors due to stray fields are eliminated.

Dielectric Loss and Power Factor Testing.—Dielectric loss tests on factory lengths of cable are carried out by means of a Duddell-Mather astatic wattmeter, which may be used at voltages up to 75,000 V on the h.p. side of the circuit, although it is normally connected in the earthed side of the circuit. The wattmeter in its screened case is seen in fig. 13. The current coil of the wattmeter is wound in sections, which can be connected in series, or in parallel, according to the charging current of the cable under test. A special switch is provided by means of which the current-coil can be inserted in the earth connection of the h.p. winding of any of the pressure transformers without breaking the circuit. In order that the leakage currents from the h.p. winding may not flow through the wattmeter coil, so causing an error, each transformer tank is lightly insulated from earth and connected direct to the low-voltage end of the h.p. winding.

The pressure coil of the wattmeter is connected to the h.p. circuit through a high resistance, so as to reduce to a minimum and determinate amount the errors which might be caused by using a potential transformer with its inherently variable error. There are, of course, known errors in the case of a high-resistance potential divider due to the internal capacity of the resistance and its earth capacity. When the wattmeter is connected on the earthed side of the circuit the earth capacity causes it to read low, while internal capacity causes it to read high. In the case of the present apparatus these errors have been reduced to a minimum by suitably disposing the apparatus, and under present conditions the magnitude of the correction necessary under any condition whatsoever, being easily calculable and checked by careful calibrations, enables the true value of dielectric loss and power factor to be arrived at. In order to make certain of this, extensive research was carried out in the Cable Research Laboratory of the Company using various methods of dielectric loss testing, and as a result it was found that when all the causes of error had been dealt with, the same absolute power factor was given by either of three methods, *viz.*, Schering bridge; dynamometer wattmeter; and null wattmeter methods.

As described above, the Duddell wattmeter can be used for the straight dynamometer wattmeter method, or by a slight circuit modification it may be used in the null wattmeter method (due to Emanueli), and at the same time check tests can be made in the Research Laboratory by means of a Schering bridge. Research work on dielectric-loss tests is continuously being carried on in the Research Laboratory, and the results of the work done are immediately available for application to the factory testing plant; thus it is possible to keep abreast of the most modern practice in this respect.

The potential-divider resistance is in the form of an oil-immersed woven-wire capacity resistance divided into three sections of 250,000 ohms, each unit being contained in a galvanised-iron tank and mounted on porcelain pillars. These units may be seen in front of the transformers in fig. 4. One of the sections is subdivided, and the wattmeter pressure coil of 100 ohms resistance is connected in parallel with the last 1,000 ohms, thus ensuring that if the pressure circuit on the instrument is accidentally broken there will not be any rise in pressure on the instrument.

Wave-Form Tests.—A Duddell oscillograph (seen on the left of fig. 13) enables the wave shape to be determined over the same range of voltage for which the dielectric losses are measured. The oscillograph is mounted on a porcelain pedestal for insertion on the h.p. side of the circuit if desired. The auxiliary resistances are mounted in the screened cage in the foreground of the picture; the oscillograph itself, which like the auxiliary resistance is inside the h.p. area, is separated from the camera by a sheet of plate glass which is tilted to avoid reflection.

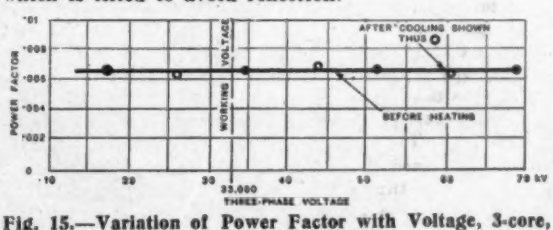


Fig. 15.—Variation of Power Factor with Voltage, 3-core, 33-kV, "H"-type Cable.

Testing Area and Control Room.—The supervolt testing tank is divided into three sections, which can be filled with water independently if a test is to be carried out with the cable immersed. When carrying out stability tests (that is, repeated heat runs followed by power-factor-variation tests to ascertain whether any deterioration has taken place due to successive heating and cooling), the best method of heating the cable, that is, the nearest possible approach to working conditions obtainable without excessive expense, is to pass current through the cores and to raise the temperature of the lead sheath to what is known to be its actual temperature in service by immersing the cable in water

which is subsequently heated, as the core temperature rises to a predetermined temperature. Thus, the actual temperature gradient which obtains in a cable when laid in the ground is actually maintained throughout the series of heat cycles which makes up the complete stability test. The temperature of the water can be raised to any desired level by steam pipes in the sides of the tanks, and connections to cables in the tanks are made by means of a special removable cage run on rails across the top of the tank. This cage, with its insulators for supporting the three leads from the loading transformers, is shown in fig. 11.

The whole of the testing area is enclosed within an expanded-steel partition which is absolutely earthed throughout. All the switching operations in connection with any of the tests are carried out from control boards outside the h.p. area, the gates of which are interlocked with the main switch of the pressure transformers in such a manner that the main oil switch cannot be closed until the gates are shut; the opening of any gate automatically opens the main switch and cuts off the pressure, and, in addition, press buttons at various points can be used to cut off pressure. A series of red lamps are interlocked with the main switch. It can thus be appreciated that the interlock system, in conjunction with that of the motor-generator circuit, provides an absolute safeguard against damage to any of the plant, or danger to any of the operators, none of whom is, of course, allowed to remain in the h.p. enclosure during a test. A further safeguard is necessary for the overhead crane, which has to traverse the area in order to place cables for test. Should the crane driver overlook the red danger signals when a test is in progress, and should the crane accidentally travel past a certain point in the h.p. area while a test is being made, a trip in the crane supply circuit will be automatically operated and its supply cut off.

The main switchgear for the control of the plant is assembled together in a convenient control desk mounted in the gallery above the testing area. This panel is shown in fig. 9: on the left-hand side of the sloping face of the desk are the pressure-transformer controls, including main switch, red and green indicator lamps, ammeter and voltmeter connected by a switch in any phase, and voltage button control for the induction regulator. In the centre of the panel are voltage and frequency meters for the alternator, and field-rheostat handwheels for both pressure and load. On the right are the corresponding controls for the load-transformer circuits. Mounted on the upright front of the panel are the motor-field rheostat for frequency controls, recording instruments for continuous records for long-time tests, fuses for the various control circuits, and a hand telephone for keeping in touch with the test operators at the wattmeter, h.p. voltmeter, and oscillograph. In the same room are desks fitted with all the necessary apparatus and appliances for making the usual routine tests, such as the determination of insulation resistance, conductor resistance, and electrostatic capacity. Two of these desks are shown in fig. 10.

Results obtained on Super-pressure Cables.—An article of this nature would not be complete without some mention of the kind of cables which have been tested with the plant, and the results obtained. Fig. 7 shows a cross section and fig. 8 a telescoped sample of a 66,000-volt cable manufactured by Standard Telephones and Cables, Ltd., in the North Woolwich factory. It was submitted to stringent tests, the results of which have been published elsewhere,* including:—

(1) A pressure test at 150,000 volts, 3-phase, for 15 minutes.

(2) Bending tests.

(3) A breakdown test at 173,000 volts, single-phase, for 15 minutes without breakdown (cores bunched), equivalent to a 3-phase test at 300,000 volts.

(4) In addition, load tests carried out showed that the power factor-voltage characteristic, which was practically flat before the cable was heated with current through the cores, was absolutely unaffected after cooling from this test.

Very recently tests have been carried out on 33,000-volt, three-core "H"-type cable supplied on contract orders, and figs. 14 and 15 show the results of power factor-temperature tests, and power factor-voltage variation tests before and after heat runs. It will be seen that not only is the power factor-voltage variation absolutely flat (which is claimed to be a proof that there was no ionisation in the cable as first made), but also that the characteristic was unaffected by the heat run, thus proving, it is maintained, that the power factor will not progressively rise with successive periods of full load and no load during service; in other words, that the cable will work satisfactorily under full-load current and voltage conditions.

* I.E.E *Journal*, Vol. 65, p. 512 (1927).

Special Meters and Tariffs.

Some suggestions for applying modern tariffs to slot-meter consumers.

By B. M. SMITH.

WITH the rapid growth in the domestic use of electricity attention is naturally being directed towards the tariff question. Attractive tariffs produce a bigger load, and in most cases a better load curve, which in turn makes a low tariff possible and profitable.

This brings up the question of meters and metering, since it is through the medium of the measuring apparatus that the charges are collected, either by quarterly bill or a slot meter. The latter method should not be overlooked or neglected, as if full development is to be made, each class of consumer must be catered for.

In Great Britain the tariff is usually either—

(*a*) Two distinct rates (lighting and heating) involving two meters;

(*b*) a form of fixed and unit charge, such as the Norwich system, or a charge on ratable value plus a price per unit;

(*c*) a sliding scale which varies with amount consumed; or

(*d*) a two-rate system based upon the time of day during which the load is taken.

There is a variation of the last-named system adopted by a German company whereby the registration change is effected by a thermal relay instead of a clock, so that the separate charges depend upon the load value and not the time of the load.

All these systems have their respective merits, but they fail to get at the man who will not have a quarterly bill, whilst if we are to fully exploit the field this type of consumer must be catered for; moreover, such consumers are likely to prove a very profitable section of the field. If this is agreed, then we are faced with the necessity of finding a means of collecting "fixed and unit" charges through a slot meter, with the one insertion to cover both charges. This may be done either by (1) making the meter creep at no load; (2) setting the slot mechanism so that the consumer must periodically put in a number of coins sufficient to cover his "fixed charge" before the switch will operate; or by (3) arranging the meter so that a proportion of each shilling inserted is taken to cover the "fixed charge," units to the value of the remainder being delivered to the consumer. In other words, the meter collects both charges, but differentiates between the two, the meter dial only registering units consumed.

The creep meter fails in two particulars: It contravenes regulations and, since few, if any, meters are

constant at 1/50th of full-load, he would be an optimist who trusted to no-load running to collect a charge even when the meter was new. The second type of apparatus misses the mark, for the man who will not have bills will not pay a periodical fixed charge through a slot. This brings us to case 3—a means of collecting both amounts by one insertion, yet differentiating between the two. This is accomplished by the principle employed by the same manufacturers—in which there are two separate driving members—the meter element and the fixed-charge element. The latter is a constant-speed element connected across the mains, driving through one side of a differential gear, whilst the meter element drives through the other side when the meter is loaded, thus returning the coin gear to zero at a speed proportionate to the consumption plus the fixed charge, or to the fixed charge alone when there is no load. Since the meter element drives only when load is on, only kWh passed are registered. Moreover, it encourages loads other than lighting, since obviously the greater the consumption the smaller is the proportion of the "fixed charge" to the whole. Should the consumer close the house for a period, the switch cuts out at zero, but the mechanism goes on and registers the amount owing on the fixed charge, which amount must be paid or inserted before the switch will go in.

This disposes of the domestic point; the other is for hotel bedroom heating. It is a fact that radiators could profitably be, but are not, used for this purpose, particularly where people only stay for, say, one night. Obviously a slot meter in each room is indicated; the weak point is that with an ordinary slot meter anything left unconsumed by one man is the profit of his successor and not of the proprietor. This offers the latter no incentive other than cleanliness compared with fires, and does not compensate him in any way for installation costs. The firm referred to earlier on has now a patented device whereby the proprietor can easily trip the switch on the departure of each guest, so that, paying through a master meter, he gets the benefit of any energy paid for but not consumed, in the same manner as he would with a coal fire, without the mess and labour. Incidentally, many men would use heat in this form who would not bother with a fire owing to the delay of it.

Each of these meters seems to be worthy of consideration, particularly where an engineer wishes to push a heating or cooking load. They seem to mark a step in the right direction, and show a real effort to fill the needs of the present age. I think that the day is not far distant when we shall have to go out after the slot-meter consumer—if it has not already arrived—and we must prepare for it.

The most obvious conclusion to come to is that engineers, in formulating their schemes and tariffs, should discuss the subject with representative engineers from meter manufacturers—and that the latter should keep the engineers posted with all new developments.

A Lifting Scheme.

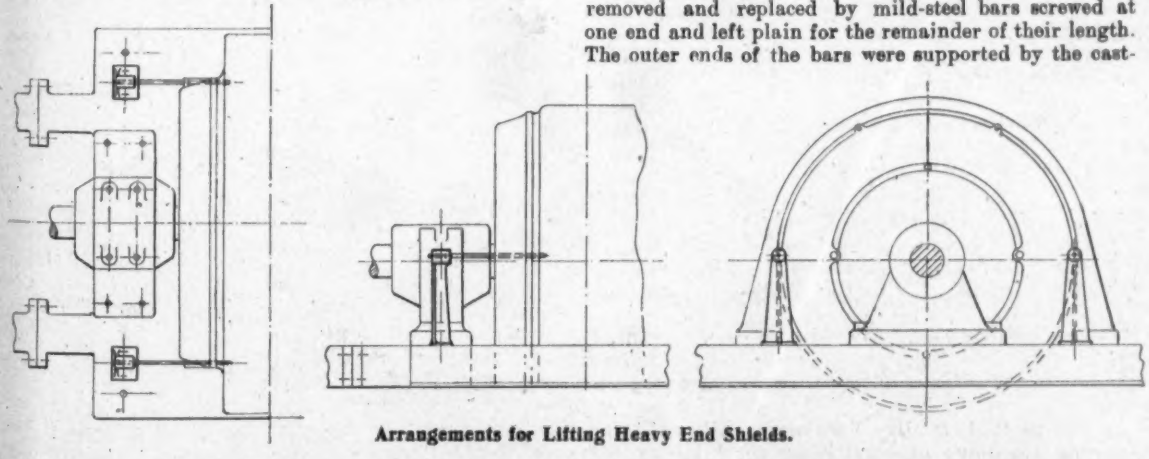
A Method Adopted for the Handling of the Heavy End Shields of a 750-h.p. Motor.

By H. WILLIAMSON, A.M.I.Mech.E.

IT is, unfortunately, necessary at times to remove the end shields of large motors. Accumulations of dust and other matter gather on the ends of the stator and rotor windings, and since these accumulations are frequently hygroscopic in character, their removal is desirable to preserve the insulation.

For various reasons—none of which is out of consideration for the customer's engineer—the motor makers provide end shields of cast-iron in two or more pieces. These shields look well and are mechanically sound, but they are heavy and very awkward to handle in the confined spaces in which many large motors are installed. Frequently it is undesirable to provide permanent lifting tackle, and often there is no room to rig up a set of blocks, while to remove these heavy sections without sound tackle is to run a big risk of damaging the projecting ends of the stator windings.

Faced with the necessity of removing the end shields of a 750-h.p. 5,000-volt motor under the above conditions, the writer devised the scheme detailed below and depicted in the accompanying illustrations. The end shields were in halves, divided at the vertical plane, and each half was secured to the stator frame by three long set-screws. Four cast-iron brackets were made and secured to the base casting, so that the holes in the brackets were exactly opposite the centre set-screws of the half-sections. These centre set-screws were then removed and replaced by mild-steel bars screwed at one end and left plain for the remainder of their length. The outer ends of the bars were supported by the cast-iron brackets. Dealing with each half shield in turn, the two remaining set screws were withdrawn, so leaving the section supported by the steel rod. Since the piece is carried about its middle point, it can be manœuvred easily along the bar until there is ample space between the shield and stator frame to permit access to the windings for cleaning. As the steel rod is rigidly supported at either end, there is no danger of the shield slipping and damaging the windings.



Arrangements for Lifting Heavy End Shields.

If there is any objection to the permanent presence of four brackets, holes may be drilled and tapped in

the proper positions in the main base and one bracket only used, this being set up opposite whichever section of the shield is to be removed.

Apart from the expense, there appears to be no reason why these end shields should not be made of sheet steel, say 10 s.w.g. Such shields would be quite strong and would be light enough to be handled comfortably by two men. However, failing this alteration in design, the device described will greatly simplify a very awkward job.

Electrical Slogans.

Some reflections on a subject of great interest at the moment; catchwords hitherto devised for the electrical industry have not been too good, and many of them have transgressed the rules which must be observed if a slogan is to perform its function.

By C. TURNBULL, M.I.E.E.

OF the making of many slogans there is no end. Slogans do more than advertise goods for sale: they also keep the advertiser up to scratch, as he has to live up to his claims. The good slogan is a simple-looking thing, which most people say is so obvious that they could have thought it out in about two minutes. Nevertheless, in spite of much prolonged labour, the electrical world has not yet got a slogan which will compare with "Say it with Flowers," or "Eat More Fruit," &c., and we need it. At the moment our gas friends are better off than we are, which is not as it ought to be.

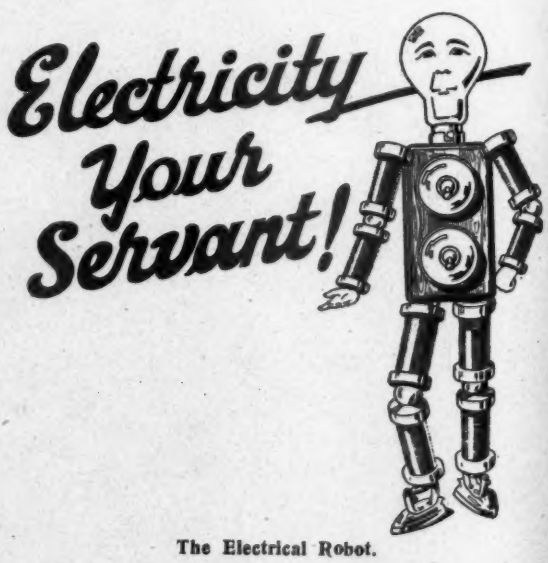
The principles of slogan making are not as well known as they should be, and need explanation to become really obvious. Consider that magnificent artificial word, assuming it is artificial, "Kodak": it is a slogan in itself, and has undoubtedly done much to augment the sale of the camera. It begins with the slow "ko-" and ends with the snap of the "-dak," probably needing weeks of work to invent. The word "Electricity" suffers from the "s" sound in "city," but it is brightened up by the "e" sound at the beginning and end. "Use Electricity" is an American slogan, but it does not run well, the word "use" being burdened with an "s," or rather "z," sound, which does not go well with "electricity."

"Electricity Saves more than it Costs" has been proposed, but it sounds rather like an apology for high prices, besides being too long. "For Health's sake use Electricity" combines many faults: it is too long, has too much "s" sound, and with its combination of "ths" in "health's" with the "s" in "sake" might be used by the police in a test of sobriety; besides, it sounds too much like an advertisement for a patent medicine, and is depressing rather than cheering in its effect. We may drink sulphur water for health's sake, but do not like it.

The sibilant "s" sound has a fatal attraction for the slogan maker, as we may see in the "Eda" Service Book. "Electricity saves Waste," "Science's greatest Gift," "Electricity sets a New Standard of Cleanliness," "Results are Always the Same" may be quoted as examples of the piling up of the "s" sound, which is just what one does not want in a slogan.

We need a short slogan to paint on delivery vans, to add to letters and circulars, something that improves with time, that conveys its meaning right away, and acquires more significance with use. May I suggest the words: "Electricity—Your Servant," which are short and snappy; although "servant" begins with "s," it is at the beginning of the word and is sandwiched between other letters, which make it innocuous. The slogan as a whole is easy to say, the meaning is obvious right away, and as the list of apparatus grows for doing all kinds of work electrically, whether in the factory, the household, or business premises, its significance will become fuller as time goes on. The picture of a Robot is more appropriate and of wider application than that of the young lad with the tennis racket who stands over the oven in some of our advertisements, a thing which provokes uncomplimentary remarks from housewives, in the northern part of the Kingdom at any rate.

Variations may be used, such as "Your Servant—Electricity," and "Your humble Servant, Electricity" would be quite suitable for the bottom of a circular, particularly if printed in good script characters. The Robot could also be developed into as many characters as Strube's "Little Man," in the *Daily Express*. He could bring gifts of fires, toasters, and kettles, or wheel



The Electrical Robot.

a barrow full of electrical stuff, or even get himself up as a flapper with high heels and a tennis racket and stand beside an electric oven in the proper style. If the idea is good, let us get in with it before our gas friends make use of it, as it would be humiliating to find them running off with our slogan and leaving us to appear as if we borrowed it from them. The Robot depicted in the drawing reproduced above is diagrammatic and must not be accepted as the final idea; I believe that other electrical Robots have been invented, which are more attractive than that here illustrated. It will pay to expend a lot of time on devising a very good Robot.

Electrical Power Engineers' Association.

The annual dinner of the Southern Division of the Electrical Power Engineers' Association will be held at the Hotel Cecil, London, on October 6th. Tickets and particulars may be obtained from technical representatives or Mr. P. Gordon Hieatt, hon. secretary, 25, Parkhurst Road, Bowes Park, N.22.

Earth or Insulate?

A consideration of some aspects of the safe use of domestic electrical apparatus, in view of the interest that is being displayed at the moment in the revival of the advocacy of the universal earthing of appliances.

By T. C. GILBERT.

WITH the coming of a standard consumers' voltage of supply, *i.e.*, 230 volts a.c., the subject of safety in connection with the use of electrical apparatus in the home becomes at once of paramount importance. Which is the best way of securing it? Methods which are adequate and sound for the factory are hardly what are required for the home—in fact, they would probably not be tolerated by any housewife who considers the appearance of her rooms in the smallest degree; and, as her opinion looms large in importance to-day, it is imperative that we do not leave her out of our consideration.

Many are the controversies that have raged around the subject of earthing, and some sort of revival of them may be expected in the near future, following on the prominence again given these problems. With a probable universal a.c. supply, the problem of fire protection is somewhat eased, but the problem of protection against shock becomes more acute.

Mr. W. R. Rawlings, in the paper on "Earthing as a Public Safeguard," which he read at the E.C.A. Conference at Cheltenham,* advanced many sound views on the subject of earthing, which will be endorsed by most electrical men without question. We shall not all, however, go as far as he did and advocate a concentric wire system (with the outer conductor uninsulated) as a way out of all our troubles. We all agree with him that the public should be made aware of electrical dangers, but the presence of danger cannot be made so obvious as in the parallel cases he mentions of gas and water. In the case of the former, the familiar smell will offend the householder's nostrils; he will usually know that the kitchen boiler is empty, and the presence of frost will enable him to take steps to protect his bathroom ceiling; but in the case of electricity, his first notification will probably be given him by Saint Peter, or whoever guards the door at the other place. A strong case thus exists for the protection of the public, in addition to making people wise, as they cannot all become skilled electricians, even if they had the inclination. The protection must be there in spite of the public and what individuals may do.

Present Conditions.

In several respects I must disagree with Mr. Rawlings: he is reported to have said: "Fortunately, members of the public can protect themselves by employing E.C.A. contractors, or by seeing to it that every electrical person employed by them is a registered contractor." This, I regret to say, is not sufficient; however conscientious a contractor may be, he *cannot* protect his client under existing conditions, as an instance from my own recent experience will indicate. An old lady recently purchased an electric kettle from us for use in her home, a small bungalow, wired many years ago with, of course, amongst other things, ordinary 2-pin plugs. The supply was then 210 volts d.c. A few months ago the kettle was returned to us to be fitted with a longer cord, which was done, and the utensil returned to her. All was apparently going well, when for some reason or other I had occasion to call on her, and found to my horror that the longer cord was required so that she could use her kettle in the garden; when I arrived she was, in fact, in the garden filling the kettle from a stand pipe which she used for her garden hose. The old lady, practically blind, held the kettle in one hand, already connected to the circuit plug, and her other hand was on the water tap, and the supply had recently been changed over to 210 volts a.c.! To my alarmed remonstrance she replied that as the switch controlling the plug was "off" (she was *always* most particular about *that*), she thought she was quite safe.

Now, we are members of the E.C.A. and registered contractors, but I fail to see how we could, under any circumstances, have foreseen that this appliance would have been used under the circumstances detailed above and have provided protection for the user. My explanation of the dangers attending certain acts in connection with electrical apparatus has practically decided the old lady to eliminate electricity for all purposes except lighting. It seems fairly obvious that, if the public is to be adequately protected, electrical apparatus must be practically fool-proof, and this protection must not entail any great cost, or the public will not choose, or will not be able, to afford it. I fear that earthing will not fill the bill, as witness Mr. C. W. Sully's comment during the discussion following Mr. Rawlings's paper, namely, "The great difficulty was to get the public to adopt something which would cost more." Protection must not cost more, or, at most, very little more.

We can rest assured that the present methods of protection adopted in factories and workshops are quite satisfactory, are rigidly enforced by competent inspectors, and probably cannot be bettered; but Mr. Rawlings seems to confuse the two entirely separate sets of conditions when he states that "At the moment it is fashionable to shroud such apparatus as holders, switches, plugs, &c., in insulating material, but even this method will not afford the protection necessary to safeguard the public against all the troubles referred to. It is obvious that even if the framework of a motor starter, or fittings, could all be protected by insulating varnish, or the like, there is still the risk of the live conductor being handled." This is true; by all means let him earth the motor starter, appearances in that case mean little, but starters are hardly likely to be found in drawing rooms, where a switch "shrouded in insulating material" will afford the housewife and children perfect protection. The workshop and the home have little in common regarding the use of electrical apparatus, and there is little doubt that it is in the home that the greatest risks exist to-day, thus meriting our more serious consideration.

Concentric Wiring.

Nor can I agree with Mr. Rawlings that the concentric system of wiring will prove a happy issue out of all our troubles. Many of the old objections to the concentric system still hold good, although one of them (*i.e.*, electrolysis due to wandering earth currents) will tend to disappear on the adoption of a universal a.c. supply system, but not completely. There is no doubt that the system is good, but the instances given of its successful use in hospitals, asylums, and public buildings in Mr. Rawlings's paper do not go to prove that the system is equally suitable for use in private houses, where an entirely different set of conditions obtains, and appearance has to be considered, to say nothing of cost.

* Elec. Rev., July 13th, 1928; pp. 78-9.

If I were to install an earthed concentric system to-day, if the circuit were d.c., no supply authority would connect it; if the system were a.c., I should probably have to supply at least one double-wound transformer at my own expense. Further, to carry the system to the logical conclusion, I should have to use only centre-contact lamps, which are not standard commodities.

However, to my mind, the greatest objection to a concentric system is that it must remain to all intents and purposes a "surface" system; that is to say, we cannot well conceal it. If we do, it will be extremely difficult to make extensions, or alterations, at any time. We cannot possibly make a good "draw-in" job with it unless we use an insulated wire for one side and the conduit for the earthed conductor, which brings me back to where I started, except that then I used two wires. Mr. Rawlings would not accept that either, as a "concentric" system proper, I venture to think.

If the concentric wiring system is concealed, can we really depend upon the sound earthing of the outer conductor? It will be remembered that the note to Regulation 101 of the eighth edition of the I.E.E Rules says: "The armouring of cables cannot in all cases be relied upon for the purposes of earthing." That note does not in any way specifically refer to concentric wiring, but doubtless the conditions under which cable armouring and the outer conductor of a concealed concentric system have to work are very similar, and the unreliability of the one may indicate unreliability of the other. If the outer conductor were to corrode away, the light might not *completely* fail, owing possibly to the small current which could be passed by the damp patch responsible for the corrosion, but one would be living in a fool's paradise. Believing our standard lamp to be earthed, we might carry it to the cellar to turn off the main water tap, and, as likely as not, immediately pass to happier regions where "earth" troubles are unknown.

Further, the Phœnix Fire Office Rule 9 says that, in addition, the outer conductor must be provided with a continuous protective metallic sheathing. If we wish to omit this, we must obtain special permission to do so. Probably protection against corrosion was in the mind of the framer of this rule rather than mechanical protection, else why "metallic" and "continuous"? Corrosion of the outer conductor will probably be dismissed as unlikely by the advocates of the concentric system, but it must not be ruled out too easily. The average installation engineer knows full well the risks that lurk in this direction in these days of corrosive cements, plasters, &c. I know of no enamel finish for conduit that will stand up to them, and precautions are nearly always taken to sink iron flush-switch boxes well below the surface finish of walls, or an ugly square of rust is sure to result, even with the best make of boxes. Electrolysis, even with a.c. supply, can result from the handy little bell or telephone leakage that uses our outer for part of its road.

Concentric systems will always fall short of requirements for domestic use in respect of flexible leads. The housewife, on whose shoulders I am placing a lot of responsibility in this article, but always as one who, being a contractor, has had a wide and varied experience of her, will not have a system of flexible metal pipes around her drawing room; nor will she have wall sockets looking like fire-hose connections on her walls, sockets obviously designed for the factory and excellent things in a factory. We unfortunate contractors have not only to deal with the housewife, but also with the super-artistic architect who designs weird and wonderful rooms; he will decidedly not have them either. If ordinary 2-core flexible leads are used with a concentric system, the whole system will be vitiated at its most vulnerable point and become no better than the cheapest two-wire system ever installed.

On the score of expense, too, the metal-clad flexible lead can never become popular, as most people will object to paying about a couple of pounds for a reasonable length for the standard lamp; and delicate artistic fittings with suspended holders might as well be fitted with garden hose from an appearance point of view; also, we must not forget Home Office Regulation 13: "Any flexible metallic conductor shall itself be efficiently earthed, and shall not itself be the only earth connection for the metal of the apparatus." The observance of this rule at once introduces a complication which will be avoided by not observing the rule, but the existence of the Regulation indicates that a serious snag exists in our complete concentric system.

If cheap concentric systems are introduced, they will probably be on a par with some of the existing lead-covered systems, which are a positive danger. The neat little parts all fit together nicely on the demonstration board, but conditions in houses, especially new ones, hardly approximate thereto. Few so-called junction boxes with their nice little earth clips will withstand the nailing down of a floor above them. I would far rather see an ordinary cheap slip-socket job than some of these systems, for in the latter one does know that the conduit is *not* earthed and the conductors have at least mechanical protection. If the concentric system is made heavy, on the lines of a factory system (which would appear to be necessary if real protection is to be achieved by this system), then it will *not* be tolerated for domestic use.

Even admitting all the claims that Mr. Rawlings makes for the concentric system with an unprotected outer conductor, it can never become universal. There will always be positions where it could not be used, which does not apply to all wiring systems, some being completely universal as regards their cable at least; and I myself should hesitate to use such a concentric system as is advocated in breweries, stables, or similar positions. Reference to the wiring rules of Manchester, Leeds, and Birmingham will bear out my opinion in this respect. Then again, concentric wiring is gradually being discarded in the case of car wiring, where other systems are proving superior; many expert opinions could be quoted in this connection. The report of the I.M.E.A. Electric Vehicle Committee dated February 20th, 1914, states c.t.s. cable to be superior to all other types for use with charging plugs, whereas concentric leads had been previously used; this view is also held by leading cable manufacturers and H.M. Chief Electrical Inspector of Factories.

Earthing Unreliable.

Having thus disposed of the concentric system of wiring, at least to my own satisfaction, I turn to my objections to earthing in any form as a means of protection in domestic installations; they are based on the fact that earthing cannot be general, and that it cannot be relied upon. As regards the first point, supply authorities will not earth their meter casings, and in many cases will not, or do not, earth their main cut-outs, &c., and it will be difficult to ensure that earthing is adequate down to the last standard lamp and pendant lampholder. Even assuming that they have been earthed, however, and that we have a completely earthed system with 3-pin plugs and all the rest of the necessary apparatus, if a householder buys himself a bowl-fire with an exposed element and, at the best, only an apology for a guard, how can earthing save that man's life when one evening in his bathroom he thinks the element has worked loose and proceeds to screw it up? The fact that the frame of the fire is earthed adds to his risk, as he is certain to grasp it; obviously the switch will be off, but it will be a single-pole one probably, and of course on the wrong side. The same consideration applies to cookers with open-type elements, but in lesser degree; the fact that frames are earthed and live portions accessible has not achieved safety, although every regulation of the I.E.E. has been observed and E.C.A. and registration have combined in forethought; rather has the risk been increased. With such loopholes existing, it cannot be said that earthing will solve the problem, and other means must be found.

(To be concluded.)

Rotary-Convertor Voltage Regulation.

A method has recently been devised for extensive voltage regulation on the d.c. side of rotary convertors.

(COMMUNICATED.)

AN interesting device has recently been developed in Germany whereby extensive voltage regulation may be obtained on the d.c. side of rotary convertors. The method is based on the following principle: The rotor of an ordinary rotary convertor is fed from alternating-current mains, but if the stator of the machine is not excited, no rotation will take place. If, now, the rotor is brought up to synchronism by means of a small auxiliary synchronous motor, direct current will be available at the commutator brushes. The auxiliary motor need only be small, just to overcome the mechanical resistances of friction and windage. When the machine is running at synchronism, one of the two fields into which the rotor rotating field may be split is stationary, and the voltage at the commutating brushes is a function of the angle of difference between the fields. Voltage regulation may therefore be obtained by varying this angle. This can be done by slowly rotating the stator of the auxiliary motor. When

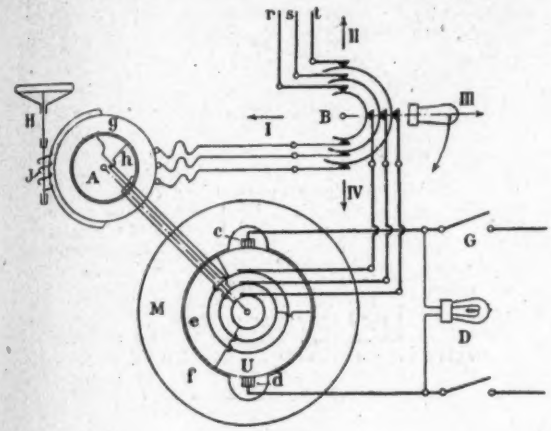


Fig. 1.

this happens, the rotor of the auxiliary motor speeds up, and the stationary field of the main machine turns through the same angle. The method, as above described, suffers from the disadvantage of imperfect commutation owing to the displacement between the field and the brushes, but this trouble may be eliminated by the use of suitable commutating poles, or better, by increasing the air-gap locally, over the section under commutation.

Fig. 1 shows the arrangement used by Mr. R. Meller, the inventor of the method. The alternating supply is shown at *r*, *s*, and *t*; B is a starting switch, and A the auxiliary motor. The latter is of the "double-fed" type, both the rotor and stator being fed from the mains, the latter directly, and the former through the convertor slip-rings. Such a motor will turn at double synchronous speed for a given number of poles, or at synchronous speed with half that number of poles.

B is first placed in position I, which feeds the auxiliary motor stator only, and A starts up as an induction motor and attains half synchronous speed. B is then moved to position II, which disconnects the stator of the auxiliary motor and connects the rotary convertor slip-rings to the mains. The rotary, now running as an inverted induction motor, comes up to synchronism and is coupled by passing the switch to position III. The auxiliary motor is now coupled and running at its normal speed, driving the rotary convertor, the slip-rings of which are also coupled to the mains. The voltages at the d.c. end can now be adjusted by rotating the stator of the auxiliary motor A. The machine is stopped by passing the switch to position IV, when the cycle of operations may be repeated. The method is claimed to have advantages over other systems, such as decreased floor space, lower cost, and a practically constant efficiency from half-load to full-load.

To consider the case of a rotary convertor with stator excitation, let us assume that the magnetic axis of the excitation field coincides with the line of the brushes. When the machine is running at synchronism, the stator and rotor fluxes practically coincide. The angle is very small, constant, and balances the mechanical resistance torque. Let α be the angle between the stator and rotor flux, ϕ_s and ϕ_r, respectively, and let 0-1, fig. 2, be the flux ϕ_s. The component of the armature reaction $\phi_r \sin \alpha$, perpendicular to ϕ_s, is represented by 1-2. The torque corresponding to the angle α will be of the form,

$$K \phi_s \phi_r \sin \alpha.$$

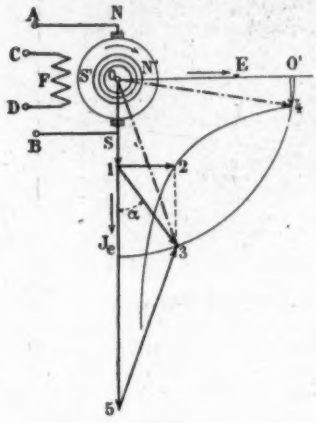


Fig. 2.

If the mechanical resistances are assumed to be constant, this torque will be constant, and the point 2 will have as locus an equilateral hyperbola with the line of the brushes as an asymptote. Assuming, as is practically the case, that the geometrical sum of ϕ_r and ϕ_s is constant, we can easily construct 1-3, which represents ϕ_r. From this we see that there exists a minimum excitation, corresponding to point 4, below which it is impossible to operate.

The d.c. voltage v depends on 1-2 alone, and is therefore proportional to 1-2. Since the flux ϕ_s shown as 0-1, is proportional to the excitation current I_e, it follows that the hyperbola may be considered as a voltage-excitation characteristic. If the machine is series wound, the product v I will remain constant over a wide range. Consequently, it will be possible to obtain voltage variation with a constant output, a point of considerable interest for certain applications, amongst which accumulator charging may be mentioned.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

A Remote Metering System.

An automatic telemetering device has recently been placed on the market by the GENERAL ELECTRIC COMPANY, U.S.A., which is designed to cover the readings of meters and instruments in all parts of a power system, and to indicate or record them on a single receiving apparatus located at some central point, such as the load dispatcher's office. The system operates over a single pair of wires, the receiver being actuated by impulses sent out by relays associated with the outlying meters. The telemeter proper is a simple speedometer calibrated in terms of the speed of the rotating meters, and consists essentially of a motor connected by a spring coupling and gearing to a permanent magnet. The motor is allowed to make one revolution for each impulse received, and this is transferred to the permanent magnet by means of a flexible spring coupling and gearing; hence the magnet also makes a definite portion of a revolution for each impulse received. The dragging effect of the revolving magnet upon a disk, to which the dial hand or recording pen is attached, translates the impulses into readings proportional to the indication of the outlying meter. Important readings such as voltage, amperes, kilowatts, reactive kilovolt-amperes, and frequency may be transmitted in this manner from all parts of the system, and the dispatcher may have either visual or recording equipment for receiving them. When kilowatts are transmitted, each impulse represents a definite number of kilowatt-hours; the telemetering device may therefore operate a demand meter or register kilowatt-hours on a dial. Further, kilowatts from several remote points may be totalised on one receiving meter. A telemetering system has recently been installed on the power system of the Montaup Electric Company, which has three double-circuit interconnections with an adjacent power network, the connecting links being at widely separated points.

A Cable Display Stand.

The accompanying illustration, fig. 1, depicts a recent introduction of Messrs. WARD & GOLDSTONE, LTD., Frederick Road, Pendleton, Manchester, a cable stand for display and stocking purposes. It is intended primarily for automobile and radio

Fig. 1.—Cable Display Stand.

cables, and is supplied as part of an order for a definite quantity of such cables. The illustration shows the stand accommodating 10 drums, each containing 100 ft. of its particular class of cable.

An Electric-driving Farm Set.

The portable electric-driving farm equipment illustrated in fig. 2, a product of the BRITISH THOMSON-HOUSTON CO., LTD., Rugby, attracted considerable attention at the recent Royal Agricultural Show at Nottingham. The outfit is claimed to be particularly adaptable to the difficult conditions of farm work, and is designed so as to be readily moved by one man

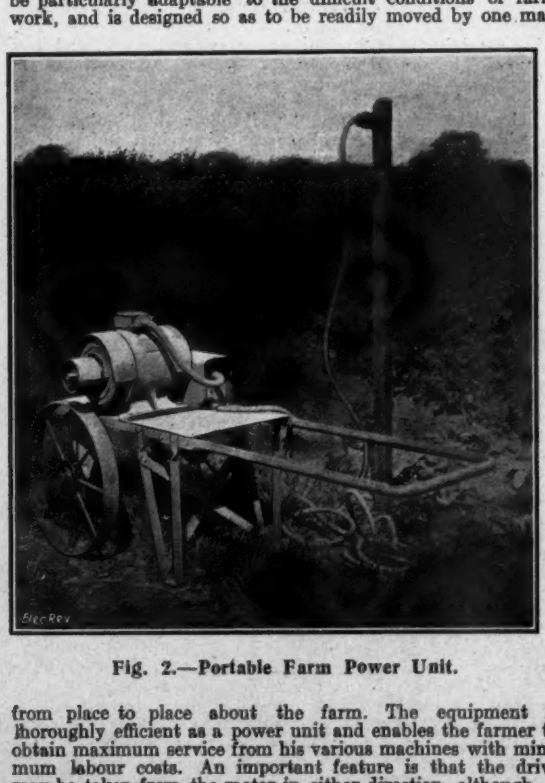


Fig. 2.—Portable Farm Power Unit.

from place to place about the farm. The equipment is thoroughly efficient as a power unit and enables the farmer to obtain maximum service from his various machines with minimum labour costs. An important feature is that the drive may be taken from the motor in either direction, although, if the duty be heavy, it is better for the pull on the belt to cause the feet of the truck to bed more firmly in the ground with increased load. The standard motor is of the drip-proof type, rated at 5 h.p., 400/440 V, three-phase, 50 cycles, and is fitted with a pulley 5½ in. in diameter with a 4-in. face. Starting is effected by a robust star-delta starter housed under a protecting cover, and connection is made to a water-tight socket by a 4-pin plug at the end of a 40-ft. length of 3-core .01-sq. in. c.t.s. cable with an earth core. Other types and sizes of motors can be fitted where necessary.

A New Adjustable Lamp Standard.

A recent introduction of Messrs. SPECIALITY SALES, 14, New Bridge Street, E.C.4, is the "Everyway" electric lamp. This embodies, it is claimed, the rigid suspension of a mobile point (the lamp) in any desired position in a complete sphere. The operation is obtained by an ingeneous design of the base and central support, which is crowned by a universal joint, allowing the free motion of the cross shafts or levers.

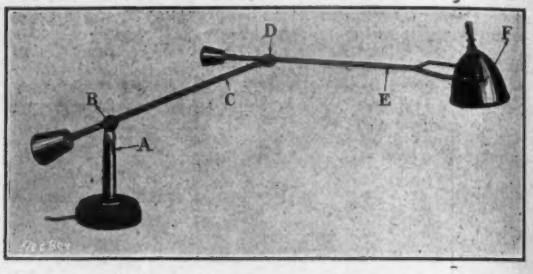


Fig. 3.—The "Everyway" Lamp.

Fig. 3 illustrates the principle applied to a 2-lever model. A is the central tubular support, B the universal joint at the head of a tube telescoping in A, to which is attached the cross shaft or lever similarly composed of two tubes telescoping in each other. The universal joint at D describes a circle if required round C, whilst the fork bearing the lamp F revolves in a complete circle at E. The lamp is also mobile within the fork F. The balance and rigid suspension of the two arms is obtained by counterweights attached to the end of each lever. These counterweights are adjustable to allow the use of shades and lamps of different makes and wattages. Many uses suggest themselves for this lamp, *e.g.*, in the dentist's surgery or the draughtsman's office.

Research in Canada.

The Ottawa correspondent of the *Manchester Guardian Commercial* states that the Dominion Government is preparing to assist the National Research Council in the erection of suitable laboratories. For this purpose a grant of $300,000 was voted in the last session of Parliament. Twenty acres of land has been purchased a few miles from the heart of the capital, and suitable buildings will be provided. A water-power site, with a capacity of 10,000 h.p., is available, and will be used to provide electricity for the laboratories. The programme of the Council falls into ten divisions—agriculture, forestry, mining, electricity, fisheries, fur production, manufacturing, radio, medical and pure science. The electrical research calls for the study of two problems—the possibility of generating electricity by utilising the wind, and the problem of storing electricity generated in this manner. It has been proved that the winds on the prairies are strong enough to drive a windmill and to generate power, but up to now scientists have not been able to devise a moderately-priced storage battery which will store the energy in sufficient quantity to supply the needs of an average farm. While Canada is rich in water-power resources, there are vast areas far removed from these sources of supply, and if the scientists are successful in designing generating machinery which can be driven by the prairie breezes, and suitable storage batteries, a great boon will be conferred upon the rural population. Other scientists are devoting their energies to investigations into pressure variations in combustion engines, and the best mixtures of rubber and other ingredients for vulcanisation. Radio research work has been directed to the invention of apparatus which will locate the causes of atmospherics.

Flashing Electric Lamps.

The question whether flashing an electric lamp shortens its life recently prompted engineers at Nela Park to conduct a series of tests, says *Industrial Engineering*, which have proved of interest to those operating sign flashers. The tests were made on thirty lamps operating continuously on alternating current, and a like number flashing on the same type of current. Similarly, tests were made on sixty lamps, half operating continuously and half flashing, on direct current. In each of the tests half of the lamps were burned horizontally and half with the base up. The results indicated that there was no great reduction of life when the lamps were flashed, and in some cases the life was actually longer with intermittent operation.

Modern Lighting Equipment.

A Visit to the Reorganised Works of the Benjamin Electric, Ltd., at Tariff Road, Tottenham.

ON Thursday last week representatives of the technical Press were entertained by the Benjamin Electric, Ltd., at its works at Tottenham, where a tour of inspection was carried out, and subsequently at lunch at Restaurant Frascati, to commemorate the opening of the new factory which has been in operation for a few months.

The new premises have resulted in doubling the total floor space of the factory, which is now organised for producing

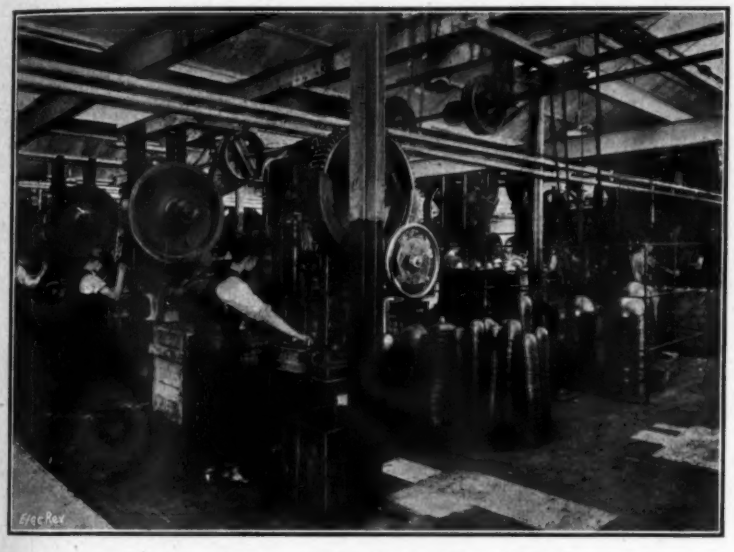


Fig. 1.—The Press Shop.

from 20,000 to 25,000 standard reflectors per week, apart from special contracts and other specialities such as wireless valve holders, Boyce Moto meters and electric horns for motor-cars. It is interesting to note that over a million and a half Benjamin wireless valve holders have been manufactured and sold since their introduction two years ago.

The extension is a brick and steel constructed two-storey building, comprising eight large North-lighted bays. The second storey is used for executive and general offices, and the ground floor for the packing and dispatching departments. The interior of the old building has been completely reorganised, and is now used solely for production purposes.

In the production of the Benjamin standard reflector the most important department as regards the factory processes is probably the press shop, which houses batteries of heavy, medium and light presses, all electrically driven by separate motors, which are in most cases fixed overhead on the steel girder work. The principal advance made recently in the production of the reflector is its construction from one piece of steel, thus eliminating the seam between the skirt and the neck which always presented some amount of difficulty, and perhaps weakness, in the vitreous enamelling processes. Credit is due to the British steel makers for their co-operation in producing a quality of steel which would stand the stresses and strains involved in shaping from one blank a 20-in. diameter reflector 17 in. high. Many processes of pickling and annealing are necessary to preserve the ductility of the metal, and properly equipped departments serve for these purposes. Fig. 1 is a view of some of the presses. It is interesting to note that for some reflectors the metal has to be pressed as many as 17 times.

To the sightseer no doubt the most interesting part of the works is that devoted to metal spinning, a considerable amount of which is carried out for special designs of reflectors. Spinnings up to 4 ft. in diameter can be handled. For the production of the various component parts of the firm's industrial lighting fittings, and also the automobile lines, an up-to-date machine shop is provided. Group driving is arranged from motors fixed similarly to those for the press motors. Fig. 2 is a view of the reflector beading section, and serves to illustrate, generally, the motor-fixing and driving arrangements throughout the factory.

An outstanding feature of the works is the tool-making department. All the tools used in the production of the firm's specialities are made in the factory, and this work keeps a considerable number of men constantly employed. Inspection plays an important part in the factory processes. From the production inspection department is controlled the inspection of the work in progress from the various shops, while a separate inspection shop is devoted to the examination of the metal surfaces which play such an important part in the finished vitreous enamelled article. In a well-equipped plating department, fig. 3, may be seen all manner of beautiful finishes given to various articles turned out in the works.

All small fittings and accessories used in the construction of the products, including the Boyce Moto meter and the Benjamin valve holder and vibrolder, are assembled in a separate assembly shop.

The company is particularly proud of its new testing and research laboratory. When the extensions were made it was felt that the research work, which had been done previously by Commander Haydn T. Harrison in his laboratory at Canterbury, should be carried out in the factory. Space was therefore provided for the purpose, and arrangements were made by which the contents of the Canterbury laboratory should be housed with those of the works testing department, thus forming, not only a very complete testing department, but also a laboratory for general research work in connection with the other special manufacturing work carried out by the company. The main photometer room accommodates an instrument 40 ft. long. This is used for measuring light intensities from fractions of a candle to over 250,000 c.p., and also for calibrating the well-known Benjamin light meter. The tests carried out in the laboratory are based on standards provided by the National Physical Laboratory, and in practice, even in the more elaborate tests, extreme accuracy has resulted.

An interesting part of the works is a flood-light and projector flat situated above the main photometer room. This is open to the sky on three sides, so as to allow for the projection of beams on surrounding buildings for judging the commercial effects, and also down an open space opposite, where intensities of over 200,000,000 c.p. can be measured at considerable distances. The main testing laboratory contains

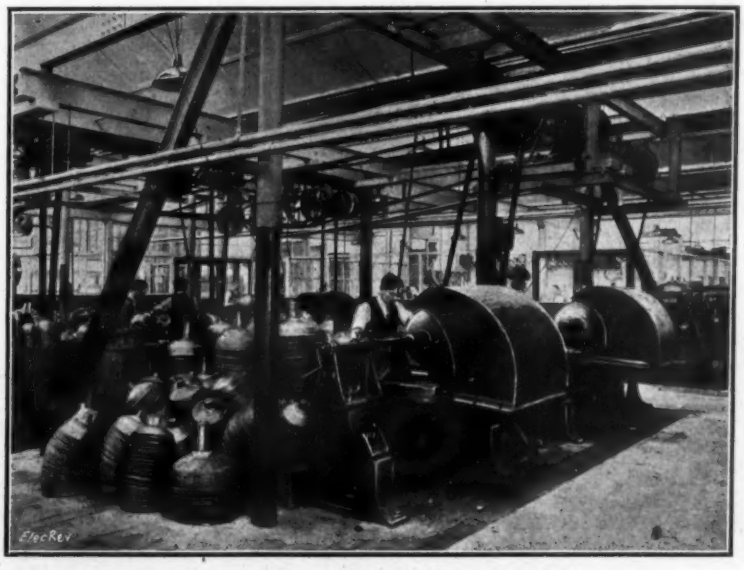


Fig. 2.—Reflector Beading Section, showing Electric Drives.

the fixed measuring instruments and standards, and it is in this department that the portable instruments used in the works are regularly tested and checked. A private laboratory contains more delicate standard apparatus, such as a measuring galvanometer and an oscillograph. The whole of the research and testing departments are under the supervision of Com-

Fig. 3.—Plating Department.

mander Harrison. The lighting of the factory is excellent. The standard of illumination is 10 ft.-candles, and Benjamin R-L-M reflectors are used throughout.

At the luncheon Mr. Guy Campbell, managing director of the company, briefly outlined the policy of the company, and called for support for the Factory Lighting Campaign of the British Electrical Development Association.

Electricity in Christchurch (N.Z.).

The Municipal Undertaking's Report for 1927-28.

We have received from the general manager of the Christchurch (N.Z.) municipal electricity undertaking (Mr. E. Hitchcock) a copy of the Department's report and accounts for the year ended March 31st last. This shows that the total revenue increased from £182,180 to £194,037, and the total

A New Sub-Station in Christchurch (N.Z.).

working costs (including interest and depreciation) from £158,183 to £171,519, reducing the gross profit from £23,997 to £22,518. The trading account shows a revenue from sales, installations, &c., of £53,930, against which were charged expenses totalling £50,944, leaving a gross balance of £2,987. These two surpluses, amounting to £25,050, were carried to the allocation account. The expenditure side of the latter account shows £11,099 to sinking fund instalments, £613 to stock reserve, and £14,952 to general reserve. The capital expenditure during the year was £43,305, the chief items being land, buildings, switchgear, cables, overhead lines, and meters.

The whole of the energy required was purchased from the Public Works Department, the total amount taken being 39,757,621 kWh, as against 33,204,149 kWh in 1926-27, when, in addition, 2,240 kWh was generated. The energy sold rose from 29,119,422 kWh to 34,894,754 kWh, the greatest increase being recorded by the domestic supply—from 9,215,724 kWh to 12,379,244 kWh. The connected load increased from 59,406 kW to 72,189 kW; the maximum load from 8,078 kW to 10,210 kW; and the number of consumers from 26,438 to 28,024. The total costs per kWh sold fell from 1.303d. to 1.180d., and the revenue from 1.497d. to 1.329d.

It is noted that, although the depression in the electrical trade continued, development went on. At the commencement of the year the rate for domestic heating and cooking was reduced from 1½d. to 1d. per kWh. The effect of this was that while the energy sold for this purpose rose by nearly 20 per cent., the revenue increased by only 6¼ per cent. A reduction the price of cookers, radiators, and other electrical equipment resulted in a marked increase in the showroom sales. Mention is made of the value of demonstrations in building up the domestic load as well as the stimulating effect of deferred-payment sales. Competition in the wiring business continued; the Department's wiring branch felt it as keenly as private firms. In each case, however, the trading departments met all expenses and showed a small margin.

The outstanding work of the year was the internal alterations carried out in the convertor station and the installation of Ferguson, Pailin ironclad switchgear controlled by a desk switchboard on the first floor platform directly above the gear. During the year the new Lines Department workshop was completed, and that Department changed over to its new quarters in April, 1927. Six new sub-stations, three of them of the pole-transformer type, were put into commission during the period, and additions were made to existing sub-stations. A site was secured in Milton Street for a main sub-station for the southern portion of the city, where a building 75 ft. by 36 ft. (shown in the accompanying illustration) has been erected. The 11,000-V underground system was increased to 26 miles 67 chains by the laying of 2 miles 65 chains during the year, and the 3,000-V overhead system was increased by 58 chains to 3 miles 36 chains.

A paragraph headed "Loans to Consumers," appears in the report, and it is stated that the total number of loans issued under the Supply Empowering Act was 2,056 up to the end of the period, the total amounting to £60,277. During the year this method of financial assistance to consumers was augmented by the extended sale, on terms, of showroom appliances, and at the close of the period the Department had 614 deferred-payment accounts on its books.

The new Wiring and Supply Regulations under the Public Works Act, 1927, came into force in July, 1927. The new regulations, coupled with the Wiremen's Registration Act of the previous year, make the requirements for both wiremen's registration and wiring installations uniform throughout the Dominion, except for such matters as are determined by local supply rates or other special requirements. The general manager points to the necessity for a Dominion Approval Board to aid and protect the buyer of electrical apparatus.

Since the power house extensions at Lake Coleridge were put into operation there has been freedom from anxiety regarding immediate requirements. The maximum load on the Lake Coleridge undertaking rose from 16,880 kW to 21,020 kW, the City's demand representing about a half in each year. The report makes reference to the dissatisfaction which exists with regard to the slow progress with the Waitaki development.

Railway-coach Cranes.

In the No. 86 Bulletin (August, 1928) issued by Messrs. Oerlikon, Ltd., a description is given of the lifting plant supplied by the Oerlikon Company to the Swiss Industrial Co. for use in the railway-coach workshops of the latter. The installation consists of two travelling cranes which can be coupled together by means of telescopic arms. When the two cranes are coupled together they can only be controlled from the driver's cab of one of the cranes, which is known as the "master crane." The two cranes can, however, also be used independently, when they are controlled from their respective driver's cabs. In order to couple the cranes they are first brought to the correct distance and then firmly secured together at both ends by means of jaws operated by handwheels. When handling complete coaches yokes are suspended to each hook; these yokes are built up of section irons and plates and provided with brackets. The main data of the double crane are as follows:—Useful load, *i.e.*, maximum weight of coach, 40 tons; span between centres of runway rails of crane, 58 ft.; lift, 27 ft.; distance between the points of suspension of the two yokes, 15 ft. minimum, 48 ft. maximum; travelling speed, about 164 ft./min.; hoisting speed at full load, about 7 ft./min.; traversing speed, about 62 ft./min. The motors are driven off a 380-volt, 50-cycle, three-phase supply.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

The Factory Lighting Campaign.

We have received from the British Electrical Development Association a copy of a booklet which has been prepared for electrical salesmen in connection with the Factory and Workshop Lighting Campaign. It comprises a series of eleven facts regarding good lighting which, properly used, should convince the most obdurate factory owner or manager of its economic and social value.

An Illumination Design Course.

The Electric Lamp Manufacturers' Association announces that the eighteenth of its Illumination Design Courses will commence at the London Lighting Service Bureau on October 10th and continue on subsequent Wednesdays until October 31st. The programme is as follows:—October 10th, Light and Visibility; October 17th, Illumination Design Data; October 24th, Lighting in the Engineering Industries; October 31st, Architectural Lighting; November 7th, Floodlighting and Electrical Advertising; November 14th, General Lighting Problems. If it is found possible, similar courses will be held simultaneously in Leicester, Manchester, Bradford, Newcastle, and Glasgow, and the lectures will incorporate much of the fresh data and demonstrations used in connection with the more comprehensive day course recently held.

The Marconi Royalty Decision.

The British Thomson-Houston Co., Ltd., points out that, although its name was coupled with that of Marconi's Wireless Telegraph Co., Ltd., in the recent application to the Comptroller-General of Patents to reduce royalties on dual and triple radio valves, it has disposed of all its broadcasting rights under the patents concerned to the Marconi Company. It therefore occupies the same position in relation to the Marconi Company as other radio manufacturers and pays the same royalties.

Price Reductions.

Messrs. Philips Lamps, Ltd., have announced reductions, as from September 1st, of the prices of their battery chargers and h.t. units, Types Nos. 450, 1,009, 3,002, and 3,003.

A "Henley" Showcard Award.

In connection with this year's Competition of Industrial Designs organised by the Royal Society of Arts, W. T. Henley's Telegraph Works Co., Ltd., offered a prize of £25 for the best design for a showcard advertising the "Henley" wiring system and suitable for display in electricity showrooms or windows. We learn that the competition only attracted a total of eight entries, and the judges report that none of these submitted fulfilled the requirements of the competition; consequently, they decided not to award the full prize of £25, but to award one of £10 to Mr. Percy Bamberger, Frodsham, Cheshire. The judges state that in most cases entrants had a wrong idea of what was wanted and submitted designs which had no reference to the electric wiring of buildings. They consider that the subject is probably a difficult one and in future competitions it has been decided that the prize donors shall give an outline of their requirements.

Telephone Cables: An Irish View.

In a comment upon the recent report of the Select Committee on Estimates which dealt with the matter of telephone cables for the General Post Office, the *Irish Electrician* says:—"The British Post Office is not at all pleased to discover that the Irish Free State Post Office is able to buy British telephone cables at considerably lower prices than it can do, the reason given in evidence before a Select Committee being that the manufacturers have to face strenuous foreign competition in the Free State and the British Colonies. We can leave the British Government to settle its own affairs in this and other matters, but we must congratulate the Irish Post Office Stores Department upon their ability to force a good bargain for the nation. We are delighted to find that world-wide rings are not yet so highly developed that the British manufacturers of electrical goods can claim 'possession' of the Irish market and treat commercial penetration by Continental and American firms as an unfriendly act. For some time we have been urging that British manufacturers must take off their whips whenever Irish Free State electrical contracts are in question if they want to secure our work. Evidently they have done so for telephone cable, and we note that a member of the C.M.A. has been given the first important contract for h.t. underground cable in connection with the national supply scheme. Motors will be the next things to throw off the shackles of the Ring, and sometime, perhaps, we may be permitted to buy lamps at a price approaching the Continental level, although the international agreements regarding the sale of lamps probably are much less easily circumvented."

An Electrical Swimming Club.

The Sun Electrical Co.'s Swimming Club is in full swing this year and the club is anxious to get into touch with other clubs in the electrical trade. Those interested should communicate with the hon. sec., Mr. W. J. Spencer, 118, Charing Cross Road, W.C.2.

Industrial Administration.

In view of the growing interest in and necessity for education in the principles of industrial administration, an announcement by the Regent Street Polytechnic of a special course in industrial administration and business management commencing on September 24th is opportune. The associated heads of the Department are Messrs. B. C. Adams, B.Sc.(Hons.) and E. T. Elbourne, M.B.E. The course is arranged in three stages, the first of which is of an introductory character, and can be passed by those possessing adequate preliminary knowledge; it covers the elements of economics, industrial psychology, industrial history and allied matters. Stage II comprises lectures in marketing and sales management; *personnel* administration and welfare; production programme and work turnover efficiency; product efficiency and quality control; purchasing and material management; works layout and plant management; process efficiency and production estimating; costing and management statistics; office method and equipment; wholesale and retail distribution; and publicity and advertising. Stage III will embrace industrial organisation and rationalisation; administrative efficiency and control of sectional technique; financial management and budgetary control; industrial economics and statistics; industrial psychology and ethics; and industrial development, invention and research. The passing of Stage III will qualify the student for the diploma of the Institute of Industrial Administration, whose first examinations will take place in June, 1929. Full particulars of the course can be obtained from the Director of Education of the Polytechnic.

New Municipal Showrooms and Offices.

The Eastbourne Corporation Electricity Committee is seeking sanction to the borrowing of £11,175 for the purchase of 59-63, Grove Road, Eastbourne, for the purposes of electricity showrooms and office accommodation.

Carnival Illumination at Melksham.

A novel scheme was organised by the West Wilts. Electric Light & Power Co., Ltd., for shop-window lighting at the Melksham Hospital Carnival held recently. As one of the features of the carnival, a window-dressing and illumination competition was arranged, prizes being offered by the Electricity Company for the best three windows. Assistance was also given by the company in the form of the loan of illumination equipment. The competition attracted a large number of entries and some very clever schemes were carried out. Electrical illumination was one of the main attractions of the carnival, over 5,000 lamps being used by tradespeople for decorating their premises. The showrooms and offices of the West Wilts Electric Light & Power Co. were outlined with lamps and a special display in the showroom window attracted much attention.

Russian Production Programme.

The programme of production for the year 1928-29, which begins on October 1st, has been fixed at a value of 248 million roubles, or an increase of 36 per cent. over the current year. The State Electrical Trust (G.E.T.) will develop the output of machines and cables in particular; the Low-pressure Trust the manufacture of radio apparatus, measuring instruments, meters, &c.; and the Accumulator Trust the production of secondary and primary batteries. It is intended to make an increase of 33 per cent. in the number of persons employed in the industry. A sum of 28 million roubles is required for the renewal of manufacturing plant and the erection of new works.

Bankruptcy Proceedings.

J. LITTLER, 5, Lansdowne Road, Southport, lately 9, Hoghton Street, Southport, Lancs., electrical and radio engineer.—The receiving order in this matter was made recently on a creditor's petition, and according to the statement of affairs there are liabilities of £1,505 against assets of £802, leaving a deficiency of £703. Debtor purchased an electrical and radio engineer's business in March, 1926, paying £200 for the stock and £200 for the book debts, for which purpose he obtained an overdraft at the bank. The business was affected by labour disputes, and little was done until November, 1926; subsequently the business improved, and in June, 1927, debtor removed to adjacent premises. Debtor states that he became aware of his position in August, 1927, and attributes his position to the general depression in trade. In November, 1927, an execution was levied and paid out. Later another execution was levied in respect of two debts amounting to £286, and under an agreement to settle the matter by instalments, debtor paid £50 and executed a power of re-entry. In May last a further execution was levied under which all the effects were sold by the Sheriff, whereupon the business was closed. A sum of £204 in respect of the sale by the Sheriff has been received by the Official Receiver. The first meeting of creditors was held recently, when Mr. A. T. Eaves, 47, Mosley Street, Manchester, C.A., was elected trustee with a committee of inspection. The following are creditors:—

	£		£
Burndept Wireless, Ltd.	137	Langham Radio Co. ...	30
Central Electric Co. ...	49	Mather Lane Spinning Co. (1920), Ltd. ...	105
Lawrence Co. (Blackpool), Ltd.	21	Philips Lamps, Ltd. ...	23
Morley Co., Ltd.	28	Rowe Bros. & Co., Ltd....	50
Mullard Wireless Service Co., Ltd.	27	Stearn Electric Co., Ltd.	63
		White, J. C.	85

E. J. G. HURLES, 8, Blackfriars Road, S.E., wireless dealer.—The first meeting of creditors was held on August 28th, at the London Bankruptcy Court, a receiving order having been made on August 15th. According to the debtor's statements in preliminary examination, he traded as a dealer in wireless valve until August, 1924, when the British Radio Valve Manufacturers' Association was formed. His business connection was subsequently lost because he was not given preferential terms. A year elapsed before he was able to get those terms. In August, 1925, he entered into a verbal agreement with another person to trade together in the name of "Industries" at 69, Blackfriars Road, S.E., for the purpose of selling radio components and valves. Subsequently he severed his connection with his partner; the latter continued to trade in accessories only, and the debtor in valves, but they both continued to use the name "Industries." In 1927 he lent money to three persons, none of whom had repaid him, and that was the primary cause of his present position. In August, 1927, he owed the B.R.V.M.A. clients about £1,420, and as a consequence his name was removed from the list, and it was not until December, 1927, that it was restored, under special conditions. He then traded as the Industries Wireless Valve Co., but the business was not a success, and early in August of this year his name was again removed from the list. He was sued by the Mullard Wireless Service Co., Ltd., who obtained judgment against him in July last, and immediately instituted the bankruptcy proceedings upon which the receiving order was made. He estimated his liabilities at £1,426, and he had no assets. The failure was attributed to lack of capital, keen competition, heavy overhead expenses, and bad debts. The estate was left in the hands of the Official Receiver to be administered in bankruptcy.

E. R. D. LINDSAY, 96 & 98, Victoria Road, Aldershot, Hants., wireless and cycle agent.—The first meeting of creditors was held on August 29th at the Official Receiver's Offices, 29, Russell Square, W.C., when Mr. R. Gourlay, the Official Receiver, presided. The liabilities amounted to approximately £1,100, and the realisable assets were estimated at £418. The Official Receiver said that he had appointed a special manager, who had been in possession for about 11 days. It was decided to appoint Mr. Rubens, 23, Surrey Street, Strand, W.C., as trustee, with a committee of inspection.

S. E. JONES and G. W. A. E. SHORT, trading as Jones & Co., Elsecar, near Barnsley, Yorks., dry battery manufacturers.—First and final dividend of 1s. 6d. in the £, payable August 29th, at the Official Receiver's Office, County Chambers, King Street, Wakefield.

R. B. LAWSON, The Avenue, Bare, Morecambe, electrical engineer.—Receiving order made August 23rd, on a creditor's petition. First meeting, September 7th, at the Official Receiver's Office, 9, Cannon Street, Preston. Public examination, September 28th, at the Sessions Hall, Lancaster Road, Preston.

J. E. DAWSON, High Street, Boston, Lincs., wireless engineer.—Receiving order made August 23rd, on a creditor's petition. First meeting September 10th, at 4, West Street, Boston. Public examination October 18th, at the Municipal Buildings, Boston.

W. ELLIOTT and P. ELAND, trading as the Burnley Armature Repairs, 13, Cow Lane, Burnley, electrical engineers.—Receiving order made August 25th, on debtors' own petition. First meeting September 8th, at the Official Receiver's office, District Bank Chambers, Blackburn. Public examination, October 9th, at the County Court House, Bankhouse Street, Burnley.

H. N. SHORROCK, 79, Granville Road, Morecambe, electrical engineer.—Last day for receipt of proofs for dividend, September 14th. Trustee, Mr. H. Parker, Official Receiver, 9, Cannon Street, Preston.

Company Liquidations.

RIDGWAY STORAGE BATTERY CO., LTD.—A meeting of creditors was held recently at Kingston, when the liquidator, Mr. Graves, said that he had been appointed liquidator the previous day upon the resignation of Mr. Dunning. The total liabilities were approximately £800 and the assets consisted of stock £300 and book debts £100. The company was formed in July, 1927, with a nominal capital of £1,000, of which £700 was issued as fully paid. The present position was attributed to an invention which, after being placed on the market was found to be useless. No resolutions were passed, and therefore the voluntary liquidation of the company will be continued with the present liquidator. The principal creditors are:—

	£		£
Lamplough, Ltd. ...	38	Pritchett & Gold and E.P.S. Co., Ltd. ...	29
Weinbau	33	London Radio Co. ...	34
Houghton-Butcher & Co.	56		

RUDOLPH CHARLES & GOFF, LTD.—A meeting of creditors was held on August 30th at the Institute of Chartered Accounts, E.C., when the chair was occupied by the liquidator, Mr. F. Hyde, 34, London Wall, E.C.2. The liquidator said that there was no statement of affairs. The company was formed in May, 1924, with a nominal capital of £1,000, of which only £100 was issued and paid up. At the outset, the company turned its attention to the sale of electrical fittings and to building operations by way of purchasing land and erecting houses for subsequent sale. At a later date, the company opened a furniture and toy business at the Arcade, Goodmayes, and in April, 1927, commenced business as auctioneers and house and estate agents. The building operations which formed the company's main business were profitable, but the electrical and estate businesses had been unprofitable. No resolutions were passed, and therefore the voluntary liquidation of the company will be continued with the present liquidator.

S. LESSER & SONS, LTD.—Winding up voluntarily. Liquidator, Mr. J. L. Howell, 2, Broad Street Place, E.C.2, appointed August 17th. A meeting of creditors was held on Wednesday last. Particulars of claims to be sent to the liquidator by October 10th.

ORION ENGINEERING CO., LTD.—A meeting is called for October 2nd at Westminster Chambers, 28, East Parade, Leeds, to hear an account of the winding up from the liquidator, Mr. W. A. Holmes.

A. & S. WINSTON, LTD., 18, Cross Street, Hatton Garden, E.C.1.—Liquidator, Mr. G. D. Pepys, Senior Official Receiver and Liquidator, Carey Street, W.C.2, released August 27th.

MARSDENS (WHOLESALE), LTD.—Winding up voluntarily. Liquidator, Mr. P. Clarkson, Preston, appointed August 20th.

CENTRIFUGAL SEPARATORS, LTD.—A meeting of members is called for October 2nd, at 14, Queen Victoria Street, E.C.4, to hear an account of the winding-up from the liquidator, Mr. A. Davidson.

Deed of Assignment.

COLIN ANKERS, 49, Palmerston Street, Bollington, near Macclesfield.—Proofs for the first and final dividend to be sent to the trustee, Mr. F. Hermann, 2a, King Edward Street, Macclesfield, by September 15th.

Private Arrangements.

L. J. KEELEY, 109, London Road, Leicester, radio engineer, &c.—A meeting of the creditors was held on August 24th, when a statement of affairs was submitted which showed liabilities of £1,085 and net assets of £470, leaving a deficiency of £615. The debtor started business in August, 1925, and during his first year of trading the sales amounted to £2,258, and there was a net profit of £126. At that time he had been associated with two partners, but these were both paid out. In the next year his sales amounted to £2,591, and there was a loss of £547, in addition to drawings of £186. For the last period the loss had been £2,235. Since the debtor commenced he had occupied various premises, having previously been at Belgrave Gate, and later at London Road, Leicester. It was decided to deal with the estate under a deed of assignment to be executed to Mr. G. W. Sparrow, together with a committee consisting of the three principal creditors.

New Australian Companies.

Among the companies recently registered in Australia are the following: Nitrolyte Battery Co., Ltd., Sydney, capital £10,000; Vacuators Pty., Ltd., Melbourne, capital £20,000; and Wholesale Electrics Pty., Ltd., capital £10,000. The last two are electric light and power companies.

New Catalogues and Lists.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria Street, S.W.1.—An illustrated brochure describing the company's transformer shops and the manufacture of this plant.

MESSRS. JOHN SHAW & SONS, WOLVERHAMPTON, LTD., Wolverhampton.—A price list of "Trojan" vacuum, anti-vibration and "half-watt-type" electric lamps.

MESSRS. GIRLING'S, LTD., Electricity Works, Maldon, Essex. —A booklet containing illustrated details and prices of "Mosaic" electric fires.

MR. ALAN WRIGHT, 124, Chancery Lane, W.C.2.—A pamphlet describing the "Inventum" electric cistern for hairdressers. Illustrated and priced.

THE WHITWORTH ELECTRIC LAMP CO., LTD., 6 and 8, Gorleston Street, West Kensington, W.14.—A price list of electric wiring accessories, bells, radio goods, t.r.s. cables and Bakelite accessories.

MESSRS. HANS RENOLD, LTD., Burnage Works, Didsbury, Manchester.—A price list of chains for industrial applications. Illustrated.

MESSRS. HOPKINSONS, LTD., Huddersfield.—Calendar cards for the remainder of the year; examples of the company's products are illustrated on the reverse of the cards.

PHILIPS LAMPS, LTD., 145, Charing Cross Road, W.C.2.—A series of coloured showcards advertising the company's loudspeaker, trickle charger, h.t. supply units, and radio transformer.

METRO-VICK SUPPLIES, LTD., Trafford Park, Manchester.—A catalogue and a folder, both well-illustrated and priced, containing particulars of "Met.-Vick" electric fires.

KORTING & MATHIESEN ELECTRICAL, LTD., 711 & 715, Fulham Road, S.W.6.—The "Kandem Quarterly Review," containing notes on lighting and the use of "Kandem" fittings and apparatus.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—A well-illustrated brochure on the lighting of schools, with views of actual installations carried out with the company's apparatus. Details and prices of fittings are included.

MESSRS. J. STONE & CO., LTD., Deptford, S.E.14.—An illustrated card advertising the company's non-ferrous metal castings.

HOUGHTON-BUTCHER (GREAT BRITAIN), LTD., 88-89, High Holborn, W.C.1.—"Houghton's Radio News" for August, containing notes on radio apparatus and developments. Also a pamphlet showing the distribution of the company's sales staff throughout the country.

SWITCHGEAR & COWANS, LTD., Elsinore Road, Old Trafford, Manchester.—A well-illustrated pamphlet describing signal controls for road traffic (J. F. Waller's provisional patent).

THE SAXONIA ELECTRICAL WIRE CO., LTD., Roan Works, Greenwich, S.E.10.—Net trade price list No. 81,928, containing prices of flexible cords, magnet and resistance wires, insulating material, cables, &c.

Circulars announcing the reduction of lamp prices and new catalogues have been received from the GENERAL ELECTRIC CO., LTD., the BRITISH THOMSON-HOUSTON CO., LTD., SIEMENS ELECTRIC LAMPS & SUPPLIES, LTD., the EDISON SWAN ELECTRIC CO., LTD., METRO-VICK SUPPLIES, LTD., POPE'S ELECTRIC LAMP CO., LTD., PHILIPS LAMPS, LTD., and the TUNGSRAM ELECTRIC LAMP WORKS (GREAT BRITAIN), LTD.

We have received calendar-blotters for February from the following:—Messrs. H. J. BALDWIN & CO., LTD. (cable cover makers, &c.), Nottingham; Messrs. MAVOR & COULSON, LTD., Glasgow; POPE'S ELECTRIC LAMP CO., LTD., London, W.C.2; Messrs. J. G. STATTER & CO., Westminster, S.W.1; and Messrs. S. ROGERS & CO., LTD., 15, Fitzroy Street, W.1.

MESSRS. A. REYROLLE & CO., LTD., Hebburn-on-Tyne.—Pamphlet No. 186/4-28, containing an illustrated description of the company's core-balance leakage protection system.

MESSRS. L. G. HAWKINS & CO., LTD., 30-35, Drury Lane, W.C.2.—An illustrated and priced pamphlet describing an electrical paint-sprayer, and the "Universal" hand vacuum cleaner.

ELECTRIC FIRES, LTD., Heatrae Works, Norwich.—Booklet No. 53, containing illustrations, particulars and prices of electric fires, cookers, water heaters, and other domestic electrical appliances.

MR. CUTHBERT ANDREWS, 47, Red Lion Street, W.C.1.—An illustrated price list of X-ray tubes, including gas and hot-cathode types.

Trade Announcements.

The T.B.T. ELECTRIC CO., LTD., has removed its London stores to more commodious premises at 36-37, Upper Thames Street, E.C.4.

The telephone number of SUPERLAMP, LTD., 92-94, Paul Street, E.C.2, is now Bishopsgate 4868 (two lines).

The telephone number of the BRITISH BROADCASTING CORPORATION has been changed to Temple Bar 8400.

The new "Caledonia" stove and electrical works of Messrs. LANE & GIRVAN, LTD., Bonnybridge, Glasgow, is nearing completion, and the company hopes to commence producing electrical appliances in three or four months' time.

Mr. G. E. WILLINGHAM has opened new showrooms at 57A, Moorland Road, Weston-super-Mare, and asks for lists, &c.

Messrs. SHOWLER, LTD., radio engineers, of Crowborough, have opened new premises at 133, Camden Road, Tunbridge Wells.

Mr. E. M. PARSONS, electrical engineer, has moved from 38a, Brook Street, to 57, Paragon Street, Hull. His telephone number (Hull 5180) remains unaltered. Mr. Parsons asks for up-to-date price lists.

The name of AUTOMATIC & ELECTRIC FURNACES, LTD., has been altered to WILD-BARFIELD ELECTRIC FURNACES, LTD.; the board and management of the company remain the same. The company claims that its new works are the largest in Europe solely devoted to the manufacture of electric furnaces.

Book Notices.

"The Hydro-Electric Power Commission of Ontario: Its Origin, Administration, and Achievements." (Pp. 39, illustrated.) Toronto: The Commission.—The purpose of this history of an important public enterprise is to show how cheaply and thoroughly the population of the province of Ontario is served with electricity, and it is, in part, a refutation of "a good deal of unjustifiable criticism directed against the work of the Commission."

Technologic Papers of the U.S.A. Bureau of Standards. No. 369, "Transmissive Properties of Eye-Protective Glasses and Other Substances." Price, 10 cents.

"Science Abstracts, A and B." Vol. XXI. Part 8. August 28th, 1928. London: E. & F. N. Spon, Ltd. Price, 3s. each.

"Insulation Testing." Pp. 68; figs. 36.—A technical treatise on the subject issued by Messrs. Evershed & Vignoles, Ltd.

"The Installation of Electric Lighting and Heating," by F. H. Taylor, A.M.I.E.E., A.M.I.Mech.E. Pp. ix+149; figs. 154. London: Chapman & Hall, Ltd. Price 7s. 6d. net.

"Patent Law and Practice," by A. W. Griffiths, B.Sc. Pp. xxvii+174. London: Stevens & Sons, Ltd. Price 7s. 6d. net.

"Dielectric Phenomena, II—Electrical Discharges in Liquids," by S. Whitehead, M.A. Pp. 137; figs. 67. London: Ernest Benn, Ltd. Price 12s. 6d. net.

Unemployment.

The unemployment returns of the Ministry of Labour showed that there was a decrease of 5,960 in the number of registered unemployed during the week ended August 20th. At that date the total was 1,308,200, as compared with 1,314,160 on August 13th and 1,044,360 on August 22nd, 1927.

Swiss Electrical Exports.

The exports of electrical machinery and apparatus from Switzerland during the first half of the current year were valued at £1,362,320, as compared with £1,092,840 in the corresponding period of 1927.

Social Event.

Brilliant weather favoured the 12th annual horticultural exhibition and garden party of the Sports and Social Club of the County of London Electric Supply Co., Ltd., which was held at the company's sports ground, Raynes Park, on September 2nd, and over 1,500 employés and friends were present. The splendid exhibits were well arranged in one of the marquees and attracted a continuous flow of visitors throughout the day. The difficult task of judging was performed by Mr. W. H. Diver, and the numerous prizes were presented by Lady Askwith, who was accompanied by Lord Askwith. The children were not forgotten, and races were arranged for them, followed by three amusing events for adults. Tea was provided in the marquees, and an al-fresco concert by "The Happy Family" concert party was much appreciated. An enjoyable day was concluded with dancing on the green which was continued long after sunset, the music being rendered by Messrs. Callender's band, which also gave an excellent programme during the afternoon. Much credit is due to Mr. F. W. Cox, hon. secretary for the day's programme, and Mr. H. Brown, hon. secretary of the club, for the arrangements made.

New Italian Companies.

Among the concerns recently formed in Italy are La Società Officina Elettromeccanica Bolognesa, Bologna, capital, 10,000 lire; La Società Costruzioni Forniture Elettriche, Florence, capital, 250,000 lire; La Società Sviluppo e Propaganda Elettroapplicazione e Similari, Turin, capital, 100,000 lire; and La Società Apparecchi Elettriche Omega (Fratelli Scafi e Cia.), Milan, capital, 100,000 lire.

New French Companies.

Among the electricity supply undertakings recently organised in France are La Société Électrique de la Région Toulousaine (23, Rue du Général Foy), Paris, with a capital of 2½ million francs; La Société des Forces Motrices du Centre (35, Rue St. Dominique), Paris, capital 110 million francs; and La Société des Forces Motrices de la Garonne (82, Boulevard Haussmann), Paris, capital 4,100,000 fr.

Fire.

Our Glasgow correspondent reports that damage to the extent of £8,000 was caused by a fire which broke out on August 31st at 120, Mountainblue Street, Camlachie, Glasgow, occupied by Messrs. Whyte, Thomson & Co., electrical engineers and nautical instrument makers. The outbreak was in a workshop, and a large portion of the roof was destroyed, along with some of the stock and contents.

Electrical Equipment for the "R.100."

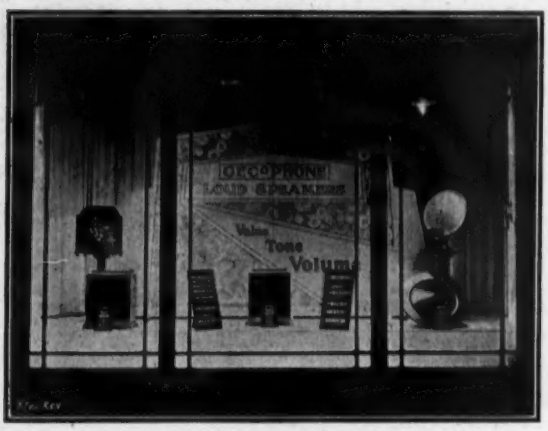
Messrs. NEWTON BROS., Derby, have secured the contract for installing the electrical equipment in the air liner "R. 100," now under construction at Cardington.

For Sale.

Carlisle Electricity Department invites offers for the purchase of five Lancashire boilers with superheaters, one tube economiser, and one steel chimney. Messrs. Fuller, Horsey, Sons & Cassell will sell by auction at the Merchants' Hall, Baltic Exchange, St. Mary Axe, E.C., on September 25th and following days, surplus machinery and stores lying at the R.A.F. No. 1 stores depôt, Kidbrooke, S.E. (See our advertisement pages to-day.)

A G.E.C. Radio Display.

A well-laid-out window, one of those of Magnet House, Kingsway, W.C.2, is illustrated herewith. It is a display of



A Display of "Gecophone" Loud Speakers.

"Gecophone" loud speakers of various types, most effective in its simplicity.

Prices of Materials.

The following prices are only general, and they may vary according to quantities and other circumstances:—

	CHEMICALS, &c.	Price Sept. 4th.	Fortnight's inc. or dec.
a	Acid, Oxalic ... ... per lb.	5½d.	...
a	Ammoniac, Sal ... ... per ton.	£60	...
a	Ammonia, Muriate (large crystal) ,,	£32	...
a	Bisulphide of Carbon ... ... ,,	...	...
a	Borax ... ... ,,	£25	...
a	Copper Sulphate ... ... ,,	£25 10s.	...
a	Potash, Chlorate ... ... per lb.	3½d. to 4d.	...
a	,, Perchlorate ... ... ,,	8½d.	...
a	Shellac ... ... per cwt.	£13 10s.	...
a	Sulphur, Commercial ... ... ,,	£11	...
a	,, Roll ... ... ,,	£11	...
a	Soda, Chlorate ... ... per lb.	3d.	...
a	,, Crystals ... ... per ton.	£5 to £5 5s.	...
a	Sodium Bichromate, casks ... per lb.	3½d.	...
	METALS, &c.		
b	Aluminium, Ingots ... ... per ton.	£95 to £100	...
b	,, Wire ... ... per lb.	1/3 to 1/9	...
b	,, Sheet ... ... ,,	1/3 to 2/9	...
p	Babbitts Metal and Anti-friction Metal—		
	Grade I ... ... per ton net.	£193	...
	Grade II ... ... ,, ,,	£185	...
	Grade III ... ... ,, ,,	£73	...
c	Brass (rolled metal 2" to 12" basis) per lb.	9¾d.	...
c	,, Tubes (solid drawn) ... ... ,,	11¾d. to 1/-	...
c	,, Wire, basis ... ... ,,	9¾d.	...
c	Copper Tubes (solid drawn) ... ,,	1/1½	...
c	,, Bars (best selected) ... per ton.	£94	...
c	,, Sheet ... ... ,,	£94	...
c	,, Rod ... ... ,,	£94	...
d	,, (Electrolytic) Bars ... ,,	£89 5s.	...
d	,, ,, Sheets ... ,,	£143 10s.	...
d	,, ,, Wire Rods ,,	£79 5s.	...
d	,, ,, H.C. Wire per lb.	9½d.	...
f	Ebonite Rod ... ... ,,	2/3 to 2/8	...
f	,, Sheet ... ... ,,	2/3 to 2/6	...
a	German Silver Wire ... ... ,,	2/3	...
h	Gutta-percha, fine ... ... ,,	6/8	...
h	India rubber, Para fine ... ... ,,	10½d.	½d. dec.
i	Iron Pig (Cleveland No. 3.) ... per ton.	66/-	...
i	,, Wire, galv. No. 8, P.O. qual. ,,	£21	...
g	Lead, English pig ... ... ,,	£23 15s.	15s. inc.
g	Mercury ... ... per bot.	£23 to £23 10s.	...
e	Mica (in original cases) small ... per lb.	3d. to 3/-	...
e	,, ,, medium ,,	4/- to 8/-	...
e	,, ,, large ... ,,	10/- to 20/- & up	...
p	Phosphor Bronze, plane castings ,,	1/9½	...
p	,, ,, drawn bars & rods ,,	1/8	...
p	,, ,, rolled strip & sheet ,,	1/9½	...
p	,, ,, wire... ... ... ,,	1/9½	...
e	Platinum ... ... per oz.	£17 15s.	...
d	Silicium Bronze Wire ... ... per lb.	10½d.	...
r	Steel, Magnet, in bars ... ... ,,	7½d.	...
n	Tin, Block (English) ... ... per ton.	£212 10s. to £213	30s. to 60s. inc.
n	,, Wire, Nos. 1 to 16 ... ... per lb.	3/6	2d. dec.

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
W. F. Dennis & Co.

Reporting regarding lead, on September 1st, Messrs. James Forster & Co. stated that there had been a steady and slightly rising market all the week, and naturally a difficulty in obtaining early lead, as the arrivals so far reported for the month were only about 12,000 tons, a quantity much below normal requirements and due to the diversion of lead to the Continent. Arrivals in September are likely to be below normal, so there may be an appreciation in market values. Very large stocks are held here, however, and it is significant that lead which has been in store for years is now offering at a slight premium over arrival quotation.

Lighting and Power Notes.

Australia.—Yallourn Extensions.—The *Electrical Engineer of Australia and New Zealand* gives details of the proposed extensions to the Victorian Electricity Commission's Yallourn power station. A report recommending the extensions is being considered by Parliament, and it is anticipated that the necessary authority for the expenditure involved will be granted. The maximum demand on the system for this winter is estimated at 83,000 kW. It is anticipated that the demand will increase rapidly, and that by 1931 it will be 119,000 kW, in 1935, 160,000 kW, and by 1937, 184,000 kW. The generating capacity at present available or practically ready to go into operation is 87,500 kW, made up of 60,000 kW at Yallourn, 16,000 kW at the Newport B power station, and 11,500 kW in the Rubicon hydro-electric plants. Next year a new generating unit of 15,000-kW capacity will be brought into operation at the Richmond power station in the metropolitan area. This will bring the total available capacity up to 102,500 kW, which will suffice for the winter of 1930. After careful investigation the Commission has recommended the installation at Yallourn of three 25,000-kW units and 12 boilers, the duplication of the 132,000-V transmission line to Melbourne, and the construction of a new terminal station at Richmond. One of the generating sets would be a reserve unit, leaving 50,000 kW available for regular use. It is recommended that the boilers be fired with raw run-of-mine coal from the new open cut at Yallourn. This extension would bring the available generating capacity of the Commission's plants up to 152,500 kW, which would care for the demand up to the end of 1934. The latest estimate of capital expenditure, which includes interest during construction, is as follows: Power station, £2,200,000; terminal station, £264,000; transmission line, £342,000; total, £2,806,000. The annual charges are estimated at £335,060 for a 35 per cent. load factor, and £366,660 for a 55 per cent. load factor. It is recommended that the first generating unit and four boilers shall be ready for service in January, 1931.

Barnard Castle.—Electricity Supply.—It is reported that a company, which has acquired the rights to supply electricity to the town, proposes to erect a power station, and in all probability a supply of electricity will be available by Christmas.

Canada. — Hydro-Electric Development.—The annual statement of the Minister of the Interior relative to the progress of water-power development in the Dominion, issued at the beginning of the year predicted an addition of 378,000 h.p. to the total installation in the Dominion during the first six or seven months of 1928. A mid-season review of conditions now indicates that during the whole year as much as 550,000 h.p. will be added, either in new developments or in additions to existing stations. There are also many undertakings in the initial stages of construction and others in active prospect which on completion will add a further 2,000,000 h.p. to the installation in the Dominion within the next few years. This new work will require a direct investment of at least $200,000,000.

Continental. — Austria. — The annual meeting of the Austrian Union of Electric Power Undertakings was recently held in Vienna when it was announced that whereas in 1913 the membership of the Union represented hydro-electric power stations of a total of 22,630 h.p. and steam-operated plants of 82,747 h.p., an aggregate of 105,377 h.p., at the beginning of the present year the membership represented 469,700 h.p. in hydro-electric stations, and 320,700 h.p. in steam stations, a total of 790,400 h.p. The greatest development has occurred in connection with hydro-electric plants, the output from which is now greater than that from steam-operated stations. The aggregate production of electricity in 1927 reached a total of 1,322 million kWh, of which 67 per cent. was generated at hydro-electric plants.

France:—The Union des Producteurs d'Energie des Pyrenées Orientales reports that during last year three new power stations with a combined annual output of 268 million kWh were completed in Southern France and brought into membership of the Union which is responsible for the economic distribution of electrical power in the Eastern Pyrenees area. Two more hydro-electric plants which will be connected to the distribution network are at present in course of erec-

tion. One of these is located near Pinet, and will have an installed capacity of 45,000 h.p., while the second at Taillebourg will have a capacity of 8,000 h.p.

RUSSIA.—The Leningrad District Electricity Supply Company is removing the meters from the premises of some 10,000 subscribers, who will be prosecuted for non-payment of the rates for electricity consumed during the summer months.—*Reuter* (Riga).

Dalbeattie.—STREET LIGHTING.—The Town Council has decided to revert to electricity for street lighting, and the work is to be carried out by the Dalbeattie Electric Light & Power Co., Ltd.

Eastbourne.—LOAN.—The Corporation Electricity Committee is applying for sanction to a loan of £3,497 for electricity purposes.

Fordingbridge.—ELECTRICITY SUPPLY.—The Rural District Council has decided to give its consent to the application of the Power Development Co. for a Special Order to supply electricity in the Council's area. The company has informed the Council that a generating station will not be established in the Fordinbridge area, but a bulk supply will be obtained from a neighbouring authorised undertaking, and this supply may be supplemented by electricity derived from the water-power resources of the area.

Greenock.—STREET LIGHTING.—The Corporation Lighting Committee recently inspected the lighting arrangements, paying particular attention to the effect of the reduction of power in electric lamps which has recently been introduced. In the principal streets the lamps have been reduced from 2,000 c.p. to 1,000 c.p., and in side streets from 300 to 150 c.p. This, it is expected, will mean a reduction in cost of £800 per annum. Satisfaction was expressed at the result of the new arrangements.

Halifax.—PROPOSED EXTENSIONS.—The Electricity Committee has asked the Town Council to reconsider the resolution which was referred back recently regarding borrowing powers of £159,028 for extensions to the electricity works.

Leicester.—INQUIRY.—An inquiry was held by Mr. F. Gordon Tucker, for the Ministry of Transport, on August 29th, into the application of the Leicestershire and Warwickshire Electric Power Co., for compulsory wayleaves over land belonging to Mr. W. Ramsey, near Markfield. Mr. Ramsey opposed the application on various grounds, and suggested that, as in the case of the coal trade, the company should pay him royalties for the transmission of electricity over his land. He thought that every owner over whose land an overhead line was erected should receive a royalty. Mr. Tucker said that he did not think the Ministry would agree with the proposal or that the electrical industry would consent to be saddled with royalties to this extent. He would, however, make a note of the point. It was the first time such a suggestion had been made to him at the various inquiries which he had conducted.

Maidstone.—ELECTRICITY SUPPLY.—The Town Council has decided to extend the supply of electricity to West Malling from the mains at the Malling research station and the refrigerating station, at an estimated cost of £9,000.

Merstham.—STREET LIGHTING.—The Parish Council has accepted the offer of the County of London Electric Supply Co., Ltd., to convert the existing street gas lamps to electricity, and to supply electricity at £1 17s. per lamp per annum, subject to a three years' agreement.

New Zealand.—LAKE COLERIDGE.—The Public Works Department has accepted the tender of Messrs. Cory-Wright and Salmon, representatives of the English Electric Co., Ltd., for a 12,650-h.p. water turbine and a 7,500-kW alternator for installation in the Lake Coleridge power station. The *Electrical Engineer of Australia and New Zealand* states that it is not long since the Lake Coleridge station was extended by the installation of two 7,500-kW units. The present installed capacity is 27,000 kW, and the station has already experienced a maximum demand of 24,370 kW.

Northern Ireland.—NEWRY (CO. DOWN).—The Electricity Commissioners for Northern Ireland have consented to the borrowing by the Urban District Council of £17,545 for electricity purposes.

Rawtenstall.—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking (engineer, Mr. C. L. E. Stewart) for the year ended March 31st last, show a total income of £65,681, and working expenditure of £38,516, leaving a gross profit of £27,164. The figures for the preceding year were: Income, £69,294; working expenses, £44,244; gross profit, £25,050. After payment of capital charges there was a net surplus of £3,769, as compared with £5,135 in the preceding year. The sales of electrical energy increased from 11,346,056 to 13,403,676 kWh, and the average price obtained per kWh fell from 1.42d. to 1.08d.

Salford.—LOAN SANCTIONED.—The Electricity Committee has recommended that application be made for sanction to a loan of £15,000 for the installation of a 33,000-V step-down transformer at Trafford sub-station.

South Africa.—PORT ELIZABETH.—The *South African Engineer* reports that the City Council has approved the electrical engineer's recommendations to carry out extensions to the electricity undertaking at a cost of approximately £350,000. It was originally intended to install one 10,000-kW turbo-generator, but the demand for electricity has been so great that it has been found necessary to install a further 3,000-kW set with the least possible delay, and it is anticipated that this will be completed in about nine months. Amongst the largest consumers to be connected to the Council's supply system are the Eastern Province Cement Co. and the Uitenhage Municipality. It was proposed at first to supply the company with an a.c. 3-phase supply at 6,600 V, but the decision of Uitenhage to take all its requirements from the Council necessitated material alterations to the scheme, and as the Cement Co.'s works are on the route of the transmission lines to Uitenhage, the Council has decided to supply these two consumers at 22,000 V by underground cables in triplicate as far as the company's works, and from there to Uitenhage by overhead lines in duplicate. Port Elizabeth will be the first municipality in South Africa to install h.p. cables at 22,000 V for the distribution of electricity.

Special Orders.—Applications have been made to the Electricity Commissioners by Mr. H. E. Phillips, authorising him to supply electricity in the parish of Kintbury, in the rural district of Hungerford, and Mr. R. Borlase Matthews, authorising him to supply electricity in parts of counties of Lincolnshire (Kesteven and Lindsey).

Stirling.—SUB-STATION EXTENSION.—The Corporation is applying for sanction to install a duplicate transformer set in the sub-station at Forth Street, at a cost of £2,000.

West Midlands.—NEW POWER STATION.—Referring to the note on p. 319 of our issue of August 24th, we learn that the initial capacity of the plant proposed is not 160,000, but 50,000 kW, and the ultimate capacity proposed is 200,000 kW. The site plans have been laid out so that low-temperature carbonisation plant can be installed if and when it is considered advisable, but such plant is not included in the initial scheme.

Wheatley.—STREET LIGHTING.—The Urban District Council has accepted the offer of the Western Electric Supply Co., Ltd., for public lighting under a ten years' agreement at £3 5s. per lamp per annum.

Wirral.—ELECTRICAL DEVELOPMENT.—Further developments in the Wirral electricity scheme are in hand, and in a short time it is expected that a new overhead cable will be constructed from the Prenton sub-station across the peninsula to link up with the already existing line at Heswall. According to the *Liverpool Post*, the new line will be erected across country to Thingwall Corner, near Arrowe Park, and on to Irby and Thurstaston, and then along the lower portion of the Heswall to Thurstaston ridge and Heswall. It is hoped that both the Barnston and Greasby areas will be supplied with electricity before the end of the year.

Tramway and Railway Notes.

Colne.—TRAMWAY SERVICE.—At a meeting of the Town Council, on August 30th, a decision to extend the existing tramway service was criticised. The chairman of the Tramways Committee said a considerable number of people had asked for trams to be run, and the committee had decided to try it for six months. It was stated that there was a loss of £1,200 per annum on this service and that as there was a splendid 'bus service running it was not advisable to re-start the tramcars. An amendment referring the matter back was carried.

London.—"UNDERGROUND" BREAKDOWNS.—A train on the Metropolitan Railway was derailed at Harrow station on the evening of August 29th, the last coach jumping the points. The service between Uxbridge and Harrow was suspended, passengers being transferred from Baker Street *via* Charing Cross to the District Railway.

The Central London Railway from Liverpool Street to Shepherd's Bush was closed from 11.40 a.m. to 1.15 p.m. on August 30th owing to the fusing of an electric cable in the Tottenham Court Road Underground station.

Manchester.—RAILWAY ELECTRIFICATION.—The Manchester correspondent of *The Times* reports that a start is expected to be made during this month with the work of electrifying the railway line between London Road terminus station, Manchester, and Altrincham, Cheshire. This branch, 8¼ miles long, is a joint undertaking of the Cheshire Lines Committee and the former Great Central and London and North-Western Railways. It is suggested that the cost of electrification of this piece of track and the provision of the necessary vehicles for use on it will be about £500,000. The branch line serves the southern suburbs of Manchester, and has stations at Oxford Road and Knott Mill within the city, at Old Trafford and Stretford in Lancashire, and at Sale, Brooklands, and Timperley in Cheshire.

The line is to be operated by means of the overhead system, and the working voltage will be 1,500 V. A generating and distributing station will have to be erected, also two substations along the line. The positions of these have not yet been chosen. It is intended to provide two new passenger stations on the 8¼ miles' course of the line—one at Ashton-on-Mersey, the other at Navigation Crossing. The scheme necessitates the enlargement of the carriage sheds at Altrincham and the building of many additional coaches, as well as the construction of electric locomotives.

New Zealand.—AUCKLAND.—The *Electrical Engineer of Australia and New Zealand* reports that as one result of the recent inquiry into tramway and motor-'bus transport in Auckland, a conference has been held between representatives of the City Council (which operates the tramway) and of outside local bodies. The conference has recommended that a transport board of 13 members should be constituted, seven members of which—for the first few years at any rate—should be nominated by the City Council and six by the outside bodies. Nomination would be on a population basis. The proposal has been unanimously approved by a representative body of suburban local authorities, but will have to be ratified by the individual authorities. The City Council is not prepared to express an opinion until the report of the commission that has been conducting the investigation has been made.

Preston.—YEAR'S WORKING.—The report of the general manager of the Corporation tramway undertaking (Mr. H. Clayton) for the year ended March 31st last shows a total income of £88,299, as compared with £82,887 in the preceding year, and working expenditure of £65,787, as against £65,467, leaving a gross profit of £22,512 (£17,420). After payment of capital charges there was a net surplus of £7,028, as compared with a deficit of £2,701 in 1926-27. The number of passengers carried increased from 14,791,581 to 15,752,503, and the car miles run from 1,169,094 to 1,185,581. The total revenue per car mile rose from 17.015d. to 17.874d.

United States.—CLEVELAND.—According to the *Electrical World*, the Cleveland Union Terminals Company has announced that all passenger trains in and out of Cleveland will be handled by electric locomotives after January 1st, 1930. The newly-electrified zone is to include about 16 miles of multiple-track route, extending from Linndale on the west through the terminal station now under construction to Collinwood on the east. A portion of this electric zone will be on the right-of-way of the New York Central and Big Four lines and the remainder on the Nickel Plate. The power distribution will be at 3,000 V d.c., with catenary overhead construction. The motive power for the initial operation will include twenty geared-type passenger locomotives. These locomotives are being built jointly by the American Locomotive and the General Electric Companies. They will have ample capacity for handling Pullman trains weighing as much as 1,275 tons trailing, equivalent to seventeen 75-ton Pullman cars. Each unit will weigh 204 tons, with 150 tons on the driving axles. The six-geared driving motors will have a total rating of 2,900 h.p. at the one-hour rating and 2,465 h.p. at the continuous rating. At each end of the locomotive will be a two-axle guiding truck designed to ensure successful operation at high speeds. The total length of each locomotive will be 80 ft. The running gear will include two three-axle Commonwealth Steel trucks coupled by an articulated joint and two two-axle guiding trucks, each carrying a weight of approximately 27 tons.

Walthamstow.—LOAN.—The Urban District Council has applied to the Ministry of Transport for sanction to a loan of £22,810 for fitting new roof covers and seating to 38 tramcars, and for fitting new electrical equipments to six tramcars, the latter work to cost £2,730.

Wolverhampton.—REMOVAL OF TRAMWAY TRACK.—The tramcar service from Bilston to Wolverhampton has been discontinued and the work of taking up the first section of the track in Piper's Row commenced. A motor-omnibus service has been organised, and will continue until the railless-car service is installed.

Telegraph and Telephone Notes.

America-Japan. — WIRELESS COMMUNICATION. — The Radio Corporation of America has announced that a direct wireless circuit has been opened between San Francisco and Tokio.—*Reuter* (New York).

Australia.—MELBOURNE.—The Federal Public Works Committee is examining plans for converting the Melbourne central telephone exchange from manual to automatic working. This change would cost nearly £585,000, but if it is carried out it is considered that it would meet telephone requirements for the next twelve years.—*Reuter* (Melbourne).

France.—NEW TELEGRAPH INVENTION.—A *Reuter* message from Paris states that an official in the telegraph service at Bordeaux, M. Clarié, has recently perfected an invention which, it is hoped, will simplify to a considerable degree the transmission of telegrams by the Baudot instrument, as well as at the same time effecting an economy. At present it is necessary to "de-charge" the apparatus by alternating positive and negative currents, the usual method being that after each signal the current is automatically reversed to clear the line. M. Clarié has tested his invention over the Paris-Bordeaux underground cable, 400 miles long. He has abolished the necessity for de-charging the cable by means of a negative current, which it is thought may mean a saving of as much as 50 per cent. All the Press messages sent from Montpellier to Paris on August 22nd were sent by the new method with success. In addition to effecting an economy, it is claimed for M. Clarié's invention that it reduces the magnetic disturbance caused by the transmission of telegrams, and should lessen by from 80 to 90 per cent. the interference caused to wireless by telegraphic transmission.

Mexico.—TELEPHONE SERVICE TO GUADALAJARA.—The Anglo-Mexican telephone service has been extended to Guadalajara in the State of Jalisco. The charge is the same as that for other places in Mexico.

Morocco. — TELEPHONE SERVICE. — The Postmaster-General has announced that the Anglo-Spanish telephone service has been extended to the City of Ceuta in Spanish Morocco. The service is available from all parts of Great Britain, and the charges for a three minutes call is: from any place in first British zone, day (8 a.m. to 9 p.m.), 26s.; night (9 p.m. to 8 a.m.), 15s. 9d.; second British zone, 27s. 9d. and 16s. 9d.; third British zone, 29s. 3d. and 17s. 9d.

Portugal.—TELEPHONE AGREEMENT.—The contract between the Anglo-Portuguese Telephone Co., Ltd., and the Portuguese Government has been completed, and the following statement has been issued by the company: "In connection with the contract which the Anglo-Portuguese Telephone Co. entered into with the Portuguese Government some months ago, whereby its franchise was settled for a period of forty years, certain questions, including the tariffs, were withheld for further adjustment. These have now been settled satisfactorily, and a Government Decree to this effect was published in the *Official Gazette* on August 27th."

The Cable Conference.—THE FIVE-WORDS CODE QUESTION.—Commander C. P. Edwards, Director of Radio, and Mr. J. M. Walker, of the Department of External Affairs, are to represent Canada at the Telegraph Union of the World Conference in Brussels. Canada and the United States of America, though neither is a member of the Union, are opposed to the ratification of the Cortina report of 1926, which proposes the reduction of the limit of letters in code words from ten to five. The Canadian Manufacturers' Association has made strong representations to the Federal Government opposing the proposed change, as it would mean a great increase in Canada's total cable bill unless a proportionate reduction were made in cable rates. Great Britain is also, it is stated, opposed to the proposed change.—*Reuter* (Ottawa).

The Telephone Service.—NEW LONDON EXCHANGE.—A new automatic exchange was inaugurated at midnight on September 1st at Bermondsey. The equipment is of the step-by-step register translator type, with an initial capacity of 2,600 lines, supplied and installed by Standard Telephones & Cables, Ltd.

Transatlantic Telegraphy.—NEW CABLE LAID.—News has been received by the Western Union Telegraph Company that the final splice of the new cable between Bay Roberts, Newfoundland, and Horta, Azores, was made on September 1st. As soon as the shore end of the cable had been connected with the deep sea portion, which was buoyed 20 miles off shore the day before by the British cable ship *Dominia*, communication was established with New York *via* Bay Roberts.

Wireless Maritime Associations.—CONFERENCE IN SPAIN.—During the Sea Industries Fair which is being held at San Sebastian in September, the meeting of Wireless Maritime Associations, which was to have taken place at Brussels, will also be held. Representatives of the wireless maritime companies of Great Britain, Belgium, France, Germany, Holland, Norway, Italy, Canada, Australia, and Spain, will attend the Conference.—*Reuter* (Madrid).

Radio Notes.

Austria.—BROADCASTING PROGRESS.—The Vienna correspondent of *The Times* reports that figures just published by the Austrian Broadcasting Company bear witness to the great popularity of the service in Austria. During the past 12 months the number of listeners increased by 45,875, bringing the total number of subscribers to 293,408. The subscription collected by the company is graded according to the income of the head of the household, or the unmarried subscriber, with a minimum fee of 14 pence per month on monthly earnings below £20 10s., and 3s. 6d. if above that figure. The biggest licensing fee is paid by dealers in receiving sets or parts domiciled in cities with more than 20,000 inhabitants. Their lowest rate is 11s. 8d. for one loud-speaker or five head telephones used for the benefit of their customers.

British Broadcasting. — RELAY STATION CHANGES. — The B.B.C. announces that during November and December ten

relay stations will take over the national exclusive frequency of 1,040 kilocycles (288.5 metres), replacing the international common frequencies which they have been sharing with stations abroad. The process will be a gradual one, each station changing its frequency as soon as the necessary additional plant is installed. Heterodyne interference has become so serious on the international common frequencies that the service areas of relay stations have shrunk to from half a mile to two miles radius during the hours of darkness, thus seriously discounting their value under existing conditions. Pending the introduction of the Regional Scheme, rather than withdraw the relay stations, an attempt will be made to revive their usefulness by the expedient of single-wavelength working. It is anticipated that this will considerably improve conditions of reception, particularly in thickly populated areas. Leeds will continue on its present frequency of 1,080 kilocycles (277.8 metres). The exclusive frequency of Bournemouth—920 kilocycles (326.1 metres)—will be transferred to Aberdeen, and the transmitter at Bournemouth will continue its service on the national frequency of 1,040 kilocycles (288.5 metres). The disadvantage of the changes will be some reduction of the proportion of local programme material at relay stations. During the main evening period of transmission all ten relay stations will be bound to radiate the same programme. Experience proves that after nightfall stations on the same frequency, even a considerable distance apart, radiating different programmes, seriously interfere with each other's service. In the daytime, when interference is less acute, "group" transmissions will probably be satisfactory ("group" programmes are those originating within the region concerned).

South Africa.—NEW JOHANNESBURG STATION.—*World-Radio* states that the transmitter in the new Johannesburg station of the African Broadcasting Company is being rapidly completed, and should be in operation in about a month's time. The new station will employ twenty times the power of the existing Johannesburg station. The transmitter will make use of the "low-power modulation" system so successfully employed by the B.B.C. at Daventry. Apart from the many smaller valves required in the initial stages of amplification, the transmitter employs five water-cooled valves, each of which has a capacity of 10 kW. The aerial system will be supported on two special lattice steel masts 160 ft. high and 300 ft. apart, similar to those which have been erected at Daventry. The earth system will consist of twelve miles of copper wire buried in the ground at a depth of eight inches, to form a herring-bone pattern. The station is about nine miles from the city, and will be connected to the studio by an overhead telephone line. The old Johannesburg equipment will probably be transferred to Bloemfontein, and will relay the Johannesburg programmes. Another relay station may be erected at Maritzburg—a mountainous district, in which reception is difficult.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Argentina.—BUENOS AIRES.—October 5th. Department of Navigation and Ports. One 20-ton electric transporter. (A.X. 6694).*

Australia.—MELBOURNE.—Posts and Telegraphs Department. November 6th. Automatic telephone switching equipment. (B.X. 4638).*

October 30th. Loading coil pots.

October 23rd. Posts and Telegraphs Department. Insulated wire. (B.X. 4674.)*

October 26th. City Council. Totally-enclosed metal-clad switchgear. (B.X. 4698.)*

November 13th. Switchboard keys and parts.*

VICTORIAN ELECTRICITY COMMISSION.—December 17th. Supply of metal-clad switchgear and accessories. (Spec. 28/68, £1 1s. for three copies.)

SYDNEY.—October 10th. N.S.W. Railways and Tramways. 2,200-V ironclad switchgear for Sefton sub-station. (Spec. 2s. 6d., from the Chief Electrical Engineer.) November 14th. Supply and erection of ash-sluicing equipment for Lithgow power station. (Spec. 819, 5s., from the Chief Electrical Engineer.)

Bedwas and Machen.—September 24th. Urban District Council. Overhead and underground mains. (See this issue.)

Belgium.—BRUSSELS.—September 27th. Municipal Council Supply and installation of a transformer plant at the central power station. Particulars from Hôtel de Ville.

Birkenhead.—September 21st. Mersey Railway Co. Stores, including electrical sundries and metallic-filament and carbon-filament lamps and fittings. Patterns and samples on view September 13th and 14th. Forms of tender, &c., from Mr. J. Shaw, general manager, Central Station.

Bradford.—Electric lighting installation, eight combined shops and houses, Swain House estate, and eight combined shops and houses, Lower Grange estate. Tenders to Mr. N. L. Fleming, town clerk, Town Hall.

Bridport (Dorset).—September 29th. Town Council. Power-house equipment, Section 2, including three generating units totalling about 600 kW. (August 31st.)

Central Scotland.—September 18th. Central Electricity Board. Civil engineering work, including reinforced-concrete structures, foundations, road, and sites for sub-stations at Clyde's Mill, Dalmarnock, and Bonnybridge. Preliminary particulars from Messrs. Kennedy & Donkin, 276, St. Vincent Street, Glasgow, or Broadway Court, Westminster, S.W.1. Specification and form of tender from the Board, 1, Charing Cross, W.C.2.

Chard.—September 17th. Corporation. Motor and pump houses, electric motors and other works in connection with the water scheme. Details from the Engineer, Mr. S. R. Lowcock, 6, Queen Anne's Gate, Westminster, S.W.1, or from the Town Clerk.

Dundee.—September 14th. Electricity Department. H.p. and l.p., paper-insulated, lead-covered and double-steel-tape armoured cable for working pressures of 6,600 and 660 V respectively. 8 and 9 mm. arc lamp carbons suitable for burning in Angold magazine flame arc lamps. (August 31st.)

Edinburgh.—October 15th. Corporation. Coal and ash plant for Portobello power station. (See this issue.)

Egypt.—CAIRO.—October 20th. Ministry of the Interior. D.c. generator set for the Beni Mazar power station. (B.X. 4660.)*

Grimsby.—September 22nd. Electricity Department. One year's supply of paper-insulated lead-covered cable. (See this issue.)

India.—September 18th. India Store Department. 187 miles of cable. October 4th. 245 electric ceiling fans. (See this issue.)

Leeds.—September 29th. Electricity Department. Supply and erection of 3-phase switchgear at Kirkstall power station. (August 31st.)

London.—H.M. OFFICE OF WORKS.—September 10th. Steel conduits and fittings for electric wiring.

September 18th. Renewal of battery plates at the National Physical Laboratory, Teddington. (August 31st.)

METROPOLITAN ASYLUMS BOARD.—October 3rd. Installation of automatic telephones at Princess Mary's Hospital. Installation of kinematograph at Darenth Training Colony. Wiring of outside supply at Colindale Hospital. (See this issue.)

Manchester.—September 11th. Tramways Committee. Supply and delivery of copper bonds for tramway rails. Specification and form of tender from the Corporation Tramways Department, 55, Piccadilly.

New Zealand.—WELLINGTON.—November 27th. Public Works Department. Generators and water turbines, in connection with Section 1 of the Waitaki power scheme. (B.X. 4677).*

Paulton.—September 17th. Board of Guardians. Electric lighting installation at the Isolation Hospital; Mr. A. J. Pictor, architect, 14, Queen Square, Bath.

Rossington.—September 18th. West Riding Education Committee. Electric lighting installation, Middle School. Particulars from Education Department, County Hall, Wakefield.

South Africa.—JOHANNESBURG.—Railways and Harbours Board. September 27th. Arc welding sets. (B.X. 4647.)*

September 27th. Town Council. Switchgear and rotary convertor.

Electricity Supply Commission. October 26th. Supply, delivery, and erection of equipment for a hydro-electric power station, Gordon's Bay hydro-electric scheme, and two outdoor sub-stations. Tenders may be submitted on any or all of the following sections:—(*a*) Waterwheels; (*b*) generators; (*c*) switchgear, relays, cables, &c.; (*d*) outdoor sub-station steel structure, switchgear and copper; (*e*) miscellaneous equipment, including precision instruments, small petrol-driven generator set, oil filter, &c.

September 27th. Bare copper wire.

October 4th. Electric cables and wires.

October 11th. Automatic telephone exchange for Cape Town.

CAROLINA.—October 1st. Municipality. Supply and erection of plant suitable for electric lighting for the town; electrically-driven pump.

—*South African Engineer.*

PRETORIA.—October 4th. Department of Posts and Telegraphs. Copper wire and lead-covered cable. (B.X. 4657.)* cables for indoor installations. (B.X. 4651.)*

SALISBURY (S. RHODESIA).—October 1st. Municipality. H.p. transmission line (10½ miles), four 250-kVA transformers, centrifugal pumps, motors, switchgear, and crane.

South-East England.—October 5th. Central Electricity Board. Supply, delivery, and erection of 132,000-V outdoor switchgear for the transforming stations in the area covered by the South-East England Electricity Scheme, 1927. (August 24th.)

Taunton.—September 27th. Electricity Department. One 2,000/3,000-kW turbo-generator with condensing plant, &c. (See this issue.)

Uruguay.—MONTEVIDEO.—State Electricity Supply Works. September 28th. R.I. wires and cables for indoor installations. (B.X. 4651.)

October 5th. Electrical material. (B.X. 4666.)*

October 17th. Automatic voltage regulator. (B.X. 4699.)*

Warrington.—September 18th. Electricity and Tramways Committee. Twelve months' supply of earthenware conduits. (See this issue.)

Waterford.—September 14th. Corporation. Single-phase and three-phase alternating-current house service and other meters. (August 31st.)

September 21st. Materials for and erection of consumers' overhead services. (August 31st.)

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Aldershot.—Town Council. Accepted:—
Cable, as follows:—750 yd. e.h.p. cable (£391); 1,400 yd. l.p. cable (£693); 4,000 yd. e.h.p. cable for housing scheme, &c., and 3,000 yd. l.p. cable for general extensions of distributors.—Callender's Cable & Construction Co., Ltd.

Australia.—VICTORIA.—The English Electric Co., through its local agents, has successfully tendered for the supply of two 10,000-kW generators to the Victoria State Electricity Commission at a price of £51,600.—*Reuter* (Melbourne).

Bath.—Board of Guardians. Accepted:—
Installation of electric passenger lift at the Infirmary (£408).—A. Marshall Hunt & Co.

Cheadle and Gatley.—Urban District Council. Accepted:—
Cables for the Broadway scheme and cables for a year.—Macintosh Cable Co., Ltd.
Switchgear.—Switchgear & Cowans, Ltd.; Ferguson, Pailin, Ltd.

Cranbrook.—Board of Guardians. Accepted:—
Laying an electric cable to the laundry and casual wards.—Powell, Ltd.

Egypt.—CAIRO.—The *Financial Times* states that the following tenders have been received for the construction of the new Cairo telephone exchange:—

	Main equipment. £E.	Inter-operating gear. £E.
Ericsson Telephones, Ltd. (London)	87,882	—
Standard Telephones and Cables, Ltd.	42,842	11,300
General Electric Co., Ltd.	69,759	—
Siemens Bros. & Co., Ltd. (London)	60,617	11,610
Automatic Telephone Mfg. Co., Ltd.	49,725	14,250
L. M. Ericsson & Co. (Stockholm)	74,153	11,800
Siemens & Halske, A.G. ...	61,929	11,320

Our contemporary says that the Ericsson Telephones subsequently cabled offering a discount of 2½ per cent.

India.—BOMBAY.—Corporation. Accepted:—
Lighting Sir Pherozshah Mehta Road (Rs.4,335).—Bombay Electric Supply & Tramways Co., Ltd.
Two sets of electric motor-driven air compressors (Rs. 16,584 each).—Turner, Hoare & Co.

Lamp Contracts.—The General Post Office has placed contracts with Siemens Electric Lamps & Supplies, Ltd., for 12 months' supply of Siemens gasfilled lamps, and with the Edison Swan Electric Co., Ltd., for gasfilled, carbon and metal-filament, and switchboard lamps.

Contracts have been placed by the Southern Railway with the Metro-Vick Supplies, Ltd., for "Cosmos" gasfilled and vacuum metal-filament ordinary, traction and train-lighting lamps, carbon-filament lamps, and automobile lamps, and with Siemens Electric Lamps & Supplies, Ltd., for 12 months' supply of Siemens electric lamps.

London.—METROPOLITAN ASYLUMS BOARD.
Re-wiring fire-alarm system, Caterham mental hospital:—

TELEPHONE & ELECTRICAL MAINTENANCE Co. (Recommended.)	£220
Choppin, O. S., & Co., Ltd.	339
Wallis, G. E., & Sons, Ltd.	341
Alpha Mfg. & Electrical Co., Ltd.	378
Uneedus Electrical Co.	398
Lewis, H., & Co.	415
Read & Partners, Ltd.	437
Anderson, A., & Son	455

Electric lighting in shore and pier buildings, Long Reach hospital:—

WALLIS, G. E., & SONS, LTD. (Recommended.)	£884
Tate, L. G., & Co., Ltd.	1,172
Douglas Electric Light & Power Co.	1,297
Clarke, T., & Co., Ltd.	1,341
Malcolm & Allan (London), Ltd.	1,624
Alpha Mfg. & Electrical Co., Ltd.	1,625
Anderson, A., & Son	1,905

Renewal of electric storage batteries, King George V Sanatorium:—

HART ACCUMULATOR Co., LTD. (Recommended.)	£496
Tudor Accumulator Co., Ltd.	525
Chloride Electrical Storage Co., Ltd.	532

With allowances of £13 14s. per ton for old plates, and £4 18s. per ton dry weight for sediment in each case.

Salford.—Electricity Committee. Accepted:—
Supply at Agecroft power station of one 16,000/20,000-kW turbo-alternator with condensing plant (£50,841).—Metropolitan-Vickers Electrical Co., Ltd.
Supply of two 100,000-lb. water-tube boilers, economisers, superheaters, &c. (£61,473).—John Thompson Water Tube Boilers, Ltd.

Scunthorpe and Frodingham.—Urban District Council. Accepted:—
3,400 yd. 1.25 sq. in. three-core cable.—Standard Telephones & Cables, Ltd.
Isolating links for cable (£52).—Metropolitan-Vickers Electrical Co., Ltd.

South Africa.—DURBAN.—Electricity Department.
2,000 porcelain shackle insulators (£96).—T. Barlow and Sons, Ltd.
Consumers' single-phase watt-hour meters.—General Electric Co., Ltd. (250); H. Davies & Co., Ltd. (250); Metropolitan-Vickers Electrical Export Co., Ltd. (500).
25 single-phase 20-kVA transformers (£26 each).—Metropolitan-Vickers Electrical Export Co., Ltd.
One 100-kVA three-phase transformer (£112).—Vincent and Pullar, Ltd.
Telephone Department.
Telephone material.—T. Barlow & Sons, Ltd. (£89); General Electric Co., Ltd. (£193); H. Davies & Co., Ltd. (£635); J. C. Ferguson (£160); Griffin Engineering Co., Ltd. (£1,120); J. M. Moir (£373); Rogers-Jenkins & Co., Ltd. (£94); Siemens Bros. & Co. (Brit.), Ltd. (£29).—*South African Engineer.*

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following:—

Importers of HAMILTON BEACH vacuum cleaners.
GARGOYLE 4-arm pendants and brackets.
Makers of SOLALAMP.
Makers of accessories in connection with LENNOX, FLENCO, and jockey pulley drives.
E.S.A. resistance bobbins.

Notes.

Association of Special Libraries.

The annual conference of the Association of Special Libraries and Information Bureaux is to be held at New College, Oxford, from September 14th to 17th. On the opening day Mr. J. G. Pearce, B.Sc., M.I.E.E., will occupy the chair at the general session in the evening, and Dr. R. S. Hutton will speak on "The Work of A.S.L.I.B." Amongst the subjects that will be discussed during the week-end are patent law reform, scientific management, indexes to technical periodicals (Mr. H. H. Johnson, A.M.I.Mech.E., A.M.I.E.E., editor of *Engineering*), vocational selection, scientific abstracts (Dr. W. Rosenhain, F.R.S., of the National Physical Laboratory), accident prevention, and the A.S.L.I.B. Directory. Non-members are invited to attend; application should be made as soon as possible to the secretary, 26, Bedford Square, W.C.1.

Illuminated Policemen on Point Duty.

It has been recognised that under certain conditions it is very difficult for the drivers of motor vehicles to see the signals of policemen on point duty after dark, and there have been several policemen run over and killed through not being visible. Experiments have been conducted in Croydon by the borough electrical engineer, Mr. A. C. Cramb, M.I.E.E., and his staff, to overcome this difficulty, and an arrangement has now been arrived at which appears to give excellent results, and on the recommendation of the police authorities has been installed at the main traffic junctions in the area. The apparatus consists of a standard motor-car headlight mounted on the nearest lamp post, fig. 1, and arranged to give a concentrated beam at an angle to the ground of about 45 deg., so directed as to illuminate

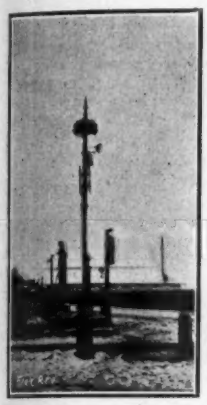


Fig. 1.—The "Croydon" Lamps.

Fig. 2.—An Illuminated Policeman.

the arms and head of the constable on point duty. A 35-watt, 12-volt automobile lamp is used, and a waterproof-type transformer is also attached to the post to step-down from the supply voltage. One of the advantages of this system is the small cost and low current consumption as compared with ordinary types of flood-light projectors on the market. Where such lights are paid for by the local authority it is possible to erect and maintain the "Croydon" lamp for an almost nominal amount. In some cases where circumstances permit, and overhead tramway wires are not in use, it is possible to hang the lamp from span wires immediately over the point-duty man, fixing the transformer on to a post at one end of the span wiring and running 12-volt leads therefrom. Fig. 2 is a reproduction of a photograph of a policeman on duty "in the lime-light."

Magnetism in Surgery.

A Canadian war veteran for nearly ten years carried a bullet in his lung. The bullet was located by means of the X-rays, but was in such a position that it could not be reached by forceps. Therefore the surgeon took a powerful magnet, and holding it over the patient's chest, drew the bullet to a point where it could be seized with forceps through the windpipe. The operation saved the patient's life. Presumably the nickel coating of the bullet provided the necessary magnetisable element.

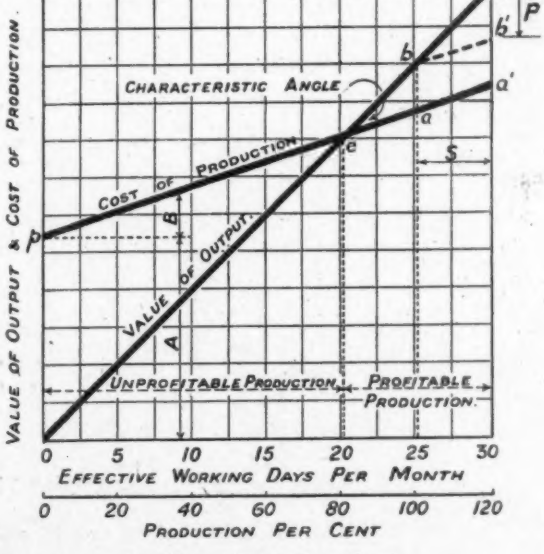
A Diesel-Electric Ship.

Trials were run on the Clyde on August 29th by the Diesel-electric oil tanker *Brunswick*, built by Scotts' Shipbuilding and Engineering Co., Ltd., Greenock, for the Atlantic Oil Shipping Co., Philadelphia. She is the first vessel built on the Clyde for propulsion by machinery of the Diesel-electric type and has internal-combustion engines made by Messrs. Carels Freres of Ghent, and electrical transmission gear by the British Thomson-Houston Co., Ltd., Rugby. The vessel attained a mean speed of 11.48 knots on her trials at full-load draft, which was practically half a knot over the speed stipulated in the contract. The main propelling machinery consists of four generating sets of Ingersoll-Rand six-cylinder engines in an engine room aft. The engines run at 225 r.p.m., and each is directly coupled to a 600-kW generator supplying direct current for propulsion purposes at 250 volts. Each engine also drives an auxiliary generator of 75 kW, 250 volts, which is arranged in tandem with the main generator; the auxiliary generators supply power for the ship's auxiliaries and also for the excitation of the main generators and the propelling motor. The main generators are electrically coupled in series, and although all four are in operation at full power, three, two, or only one set may be used for reduced power, the combined voltages being 1,000, 750, 500, and 250 V, according to the number of sets on the propelling circuits. The main propelling motor is rated at 2,800 shaft h.p. at 95 r.p.m. It includes two units, each complete with a separate magnet frame, armature, and commutator, the two armatures being electrically connected in series and mounted on a common shaft supported between two pedestal bearings. As the propeller motor consists virtually of two motors in series, it is possible to develop power for about three-quarter speed with only one half of the motor in commission.

Starting, stopping, and reversing of the propeller motor are effected entirely by varying the excitation of the main generators, or generator, as the case may be. The control arrangements are such that the main propelling circuits are never interrupted and all regulation and reversing is carried out by varying the field circuits only. Provision is made, however, for isolating any of the generating sets as may be desired. The control is carried out by means of a lever attached to a small controller fixed to the front of a sheet panel carrying the necessary instruments, this lever being moved by the operator to either side of a central stop point so that when manœuvring all that has to be done is to move the lever on the bridge of the vessel to the speed point required, either ahead or astern. The actual varying of the propelling generator fields during manœuvring is effected by means of a reversing potentiometer rheostat common to each generator field circuit, the rheostat being operated through gearing by a small electric motor. A special type of overload current relay in the main circuit is arranged so that should the operator attempt to accelerate or decelerate too quickly, and so cause excessive current to flow in the system, the relay will interrupt the supply to the small rheostat motor, and although the bridge lever may be operated quickly the varying of the generator field strength is only carried out when the relay again completes the supply circuit to the small motor. All the engine-room auxiliaries and deck machinery, including pumps, fans, compressors, winches, &c., are electrically driven. The total power of the auxiliary motors is 550 h.p., and the sizes of the individual motors range from one to 80 h.p. The voltage of the power circuits is 250 V, while for lighting purposes a balancer set, 250 to 125 volts, is provided.

Steam Storage in Factory Operation.

In a book entitled "The Storage of Steam—a New Industrial Era," by Alfred J. T. Taylor, managing director of Messrs. Ruths Steam Storage, Ltd., useful information is given on the subject of steam storage as a means of increasing the profit-earning capacity of the factory. A feature of the publication is a chart, reproduced herewith, based on Dr. Ruths' extended investigation of the subject of profit and production. The total cost of production is made up of two quantities: A, a fixed quantity independent of the output of the factory; and B, a variable quantity proportional to the output of the factory. In the diagram, peaa' represents the cost of production, A being the fixed quantity, and B the variable quantity, while oebd, drawn at an angle of 45 deg., represents the value of the output plotted against production, indicated, for the present purpose, in working days per month and in per cent. With zero production, the factory is run at a dead loss, repre-



Profit and Production Chart.

sented by cp. As production increases, the loss gradually diminishes until, at some point e, the value of the output exactly equals the cost of production. Profit is registered only when the production exceeds this critical quantity. The time taken to reach the critical point, measured in so many working days per month, and the value of the characteristic angle, are of fundamental importance in studying the relationship betwen profit and production. Calling a given increase in production s, and the corresponding increase in profit P, then the ratio P/s, which is called K, is a direct measure of the characteristic angle. The value of K is sensibly a constant characteristic for any one industry, and its variation in that industry over a wide range of industrial conditions is,

to all intents and purposes, negligible, due to the simultaneous variation in the cost of raw materials and the market value of the finished product. Approximate values of K in various industries are as follows:—Mechanical pulp industry, 0.60; cellulose industry, 0.45; textile industry, 0.43; chemical industry, 0.42; and fine paper industry, 0.40. Generally speaking, the finer the product the smaller is the value of the constant K, due to the greater relative cost of raw materials, including the cost of coal and power. From the above it will be appreciated that increased production is, first and foremost, the best method of obtaining the maximum return on a given capital investment. In point of fact, a detailed consideration of all the factors which influence the financial success, or otherwise, of an industrial undertaking shows conclusively the importance of those factors which limit the output of one section of the plant or another, and nothing offers greater possibilities in the way of increased profit than a means of maintaining the output of each unit at its maximum. In this connection, the merits of the steam accumulator, it is claimed, are altogether outstanding.

An American Diesel Trawler.

The 143-ft. vessel which has been designed by Cox and Stevens, New York City, for an American firm for the United States fisheries, is in some ways a noteworthy craft. Tenders have been called for, and it is understood by the *Motor Ship* that an order for one or more of these trawlers will be placed in the near future. The size and machinery power are not unlike those of some of the trawlers engaged in the North Sea fisheries. A six-cylinder Diesel engine of 600 b.h.p. at 200 r.p.m. is to be installed for propulsion, and at the forward end of the engine-room, in the recess between the deep tanks, a 60-kW Diesel-driven generator will supply electric power to the trawl-winch. Other engine-room auxiliaries will include two 10-kW oil-engine-driven sets for lighting and for general purposes when the engine is under way, an electrically-driven auxiliary compressor and a small steam boiler. The trawl-winch will be electrically driven: it will have automatic tension control, with two drums taking about 500 fathoms of ¾-in. wire on each side. The normal pull of the winch will be 15,000 lb. at 90 ft. per minute, the motor being of 60 to 70 h.p. Forward on the main deck will be another motor-driven winch capable of lifting 15 cwt. at 275 ft. per minute and coupled to a 15-h.p. motor.

Educational.

NORTHAMPTON POLYTECHNIC INSTITUTE.—Full-time courses, evening classes, and three scholarships in engineering. Further particulars and prospectuses from the principal, Mr. S. C. Laws, at the Institute.

THE POLYTECHNIC, REGENT STREET, W.1.—Special courses of lectures on electrical technology. Further particulars from the Director of Education.

L.C.C. SCHOOL OF ENGINEERING AND NAVIGATION.—Courses in electrical engineering and electrical installations will commence on September 24th. Enrolment during the week commencing September 17th. Prospectus and particulars from the secretary at the school.

HACKNEY INSTITUTE.—Electrical Engineering Department.—The 1928-29 session commences on September 24th. Enrolment during the preceding week. Particulars on application at the Institute. (See our advertisement pages to-day.)

ROYAL TECHNICAL COLLEGE, GLASGOW.—The calendar for 1928-29 is now available. The winter session begins on September 25th, enrolment for the evening classes commencing on September 19th.

Sydney Bribery Charges.

The appeal of Mr. S. Y. Maling, formerly deputy general manager of the Sydney municipal electricity department, against the sentence of six months' imprisonment and a fine of £500, has been referred to the High Court. Mr. Maling was charged with receiving money from Babcock & Wilcox, Ltd., in consideration of his recommending their tender for power plant.

Fatalities.

An inquiry into the circumstances attending the death of two employés at the Lochaber hydro-electric scheme, who received fatal electric shocks, was conducted by the Sheriff and a jury at Fort William. It was shown that an electrician and another workman had accidentally come into contact with "live" wires, the voltage in one case being 11,000 V, and that death resulted from electric shock. The jury recommended that where cables were being run through the tunnel it should be compulsory for the electrical energy to be switched off while the cable was being handled, and that responsibility for this should be placed in the hands of selected workmen.

Thomas Clarke, an employé of Ilford Borough Council, received a fatal electric shock on September 3rd while working on the switchboard at the electricity station in Uphall Road.

Appointments Vacant.

Electrician to take charge of distribution system, for Preesall Urban District Council. Switchboard attendant, for Scarborough Electricity Department. Switchboard supervisor at Portobello power station, for Glasgow Corporation. District mains engineer and junior assistant mains engineer, for Hackney Electricity Department. (See our advertisement pages to-day.)

Electric Power in Tin Smelting.

In view of the fact that the British Empire possesses the bulk of the world's tin ore resources, it is gratifying to record that the Penpoll Tin Smelting Co., Ltd., owns the largest and most scientifically-constructed tin smelting plant in Europe. This was started up on July 13th by Lord Derby, at Bootle, Lancs. The plant has already created employment for more than 200 workers, and is capable of turning out 1,000 tons of tin per month. The promoters—the London Tin Syndicate—have provided facilities for considerable extensions, which it is anticipated will be required in the near future.

Of the eighteen electric motors in use at this plant, thirteen are of Crompton Parkinson make; the draught necessary for the furnaces is induced by two Keith Blackman fans each driven by a 17-b.h.p. Crompton Parkinson motor, and the gases at this point reach a temperature of 200 deg. C. The exhaust is drawn through a Lodge-Cottrel plant in order to recover any tin oxide which would otherwise be lost. The conditions in which the motors have to operate called for thorough protection against damp and fumes, and it is claimed that the rotors are practically indestructible.

The Faraday Society.

A general discussion on "Homogeneous Catalysis" will be held in the Physical Chemistry Laboratory of the University of Cambridge, on Friday and Saturday, September 28th and 29th, 1928. Professor C. H. Desch, D.Sc., F.R.S., will take the chair, and an introductory paper will be read by Dr. T. M. Lowry. The programme includes eight papers in Part I—General Relations, four in Part II—Intermediate Addition-Compounds and Chain Reactions, and seven in Part III—Neutral Salt and Activity Effects. By the kindness of the College authorities, accommodation will be provided for members and visitors at Pembroke College. The charge is 22s. 6d. for members and 30s. for non-members of the Faraday Society. Applications should be sent to the secretary as soon as possible.

Institution of Electrical Engineers.

NEW TELEPHONE NUMBER.—The Institution's telephone number has been changed to Temple Bar 7676.

Institute of Wireless Technology.

The 1928-9 session of the Institute will commence in October, and an attractive programme is being drawn up. A review of the past year's activities indicates a very satisfactory state of affairs, the *Journal* of the Institute, especially, having given increased satisfaction. The growth of the Institute continues, applications for membership having been received from all parts of the world. Those interested in the Institute are invited to communicate with the hon. secretary: Harrie J. King, F.C.C.S., 71, Kingsway, London, W.C.2.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

Mr. W. F. MAY, of Maidenhead, has been appointed to the position of mains assistant at Guildford electricity works, recently advertised, and Mr. H. R. BILLING, of Pontypridd, has been appointed installation superintendent.

The marriage took place, at Durham, on August 18th, of Mr. CHARLES RITCHIE, M.I.E.E., and Miss BERTHA HINDLE, youngest daughter of Mr. F. Hindle, of Findon Hill.

On the occasion of his marriage, Mr. WILLIAM GEORGE PITT was presented recently with a clock by the staff of the Stretford Urban Council Electricity Department.

Mr. P. P. RICHARDSON, turbine superintendent at the Halifax Corporation electricity works, has resigned, and the Tramways and Electricity Committee recommends the appointment of Mr. H. FISHER, boiler house superintendent, as resident engineer at the power station, with an increase in salary of £100 per annum. A generating engineer is to be appointed at a commencing salary of £400 per annum, rising by £25 a year to a maximum of £500.

The Aldershot Town Council has decided that the salary of the borough electrical engineer, Mr. GARSIDE, shall be in accordance with the award of the A.M.E.E. His present salary is £600 a year.

M. COLARDEAU, technical director of the Société Française Thomson-Houston, of Paris, has lately been appointed a Chevalier of the French Legion of Honour.

At Morecambe last week the wedding took place of Mr. WILLIAM TURNER BROWN, of Messrs. Brown & Birchall, electrical engineers, and Miss FLORENCE HARRIS, of Heckmondwike, near Bradford.

On the occasion of his marriage, Mr. T. S. MICKLETHWAITE, of the staff of the Yorkshire Electric Power Co., was recently presented with a case of fish cutlery by the staff of the Testing Department.

Obituary.—MR. J. G. A. HART.—The death took place suddenly on August 23rd, at his residence at Edinburgh, of Mr. James George Anthony Hart, of the Hart Electrical and Mechanical Engineering Co., of Leith, in which business he was the sole partner. He served his apprenticeship at Woolwich, and specialised in electrical work whilst electrical engineering was in its infancy. Later he was for some time works manager for Bruce Peebles & Co., Ltd., and 25 years ago he established his own business at Leith, and carried out contracts in various parts of the country. The business of the company will be continued on behalf of his widow.

HON. G. SWINBURNE.—According to Press reports from Melbourne, the Hon. Geo. Swinburne, M.Inst.C.E., M.I.Mech.E., a member of the Victorian Electricity Commission, fell dead when about to make a speech in the Victorian Legislative Council on Tuesday. He was chairman of the Mount Lyell Mining & Railway Co. and a director of the Electrolytic Zinc Company of Australasia. He was born at Newcastle-on-Tyne in 1861.

MR. S. M. GLUCKSTEIN.—We regret to record the death, following an operation, at the age of 44 years, of Mr. Samuel Montagu Gluckstein, son of one of the founders of J. Lyons & Co., who was in control of the engineering, electrical and transport department of that company.

MR. HENRY MATTINSON.—We regret to learn that Mr. Henry Mattinson, the general manager and chief engineer of the Manchester Corporation Tramways Department, died suddenly on Sunday, while away at Salcombe on holiday. He was 52 years of age. Mr. Mattinson followed Mr. J. M. McElroy in the managership some ten years ago. We shall refer further to his career next week.

Wills.—It is interesting to note in *The Times* that Mr. ROGER WILLIAM WALLACE, K.C., has left £10 gross and nil net personalty. We recorded the death of Mr. Wallace in the ELECTRICAL REVIEW for December 17th, 1926, page 1004, where we mentioned his prominent connection with various well-known electricity supply and other undertakings. He was also the first chairman of the R.A.C.

The late Mr. WALTER CLAUDE JOHNSON, formerly chairman of Messrs. Johnson & Phillips, Ltd., left £481,413 gross (£452,121 net personalty). He bequeathed legacies to a number of employés.

MR. GEORGE G. P. BRODIE, late chairman of Messrs. Parker, Winder & Achurch, Ltd., who died in May last, left unsettled property valued at £176,998 (net personalty £167,515).

The late Mr. WILLIAM E. FREIR, editor and part proprietor of the *Electric Railway and Tramway Journal*, left £1,277 gross (£1,139 net personalty).

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Electrolumination (Abadie Process), Ltd.—Private company. Registered August 27th. Capital, £5,000 in 2,000 7½ per cent. cumulative ordinary shares of £1 each and 60,000 deferred shares of 1s. each. Objects:—To adopt an agreement with J. B. J. M. Abadie, 1, bis, Rue Dieulafoy, Paris, and L. Sinai, 43, Boulevard Exelmans, Paris, trading as L'Electro-Luminescence at 26, Rue Martin Bernard, Paris, and to carry on the business of electricians, engineers and manufacturers of and dealers in electrical condensers and electrical apparatus of all kinds, including luminous electric discharge tubes, radio apparatus, high-pressure protective apparatus, &c. The subscribers (each with one ordinary share) are:—C. M. Stonor, 26, Palmerston Road, S.W.19, clerk; V. Langridge, 60, Heaton Road, Mitcham, Surrey, clerk. Solicitors: A. Veasey & Co., Aldwych House, W.C.2.

John Heckie, Son & Co., Ltd.—Private company. Registered in Edinburgh on August 22nd. Capital, £5,000 in £1 shares. Objects:—To carry on the business of mechanical and electrical engineers, &c. The directors are:—J. Heckie, 58, Laidlaw Street, Glasgow, engineer; M. Caldwell, "Bon-Accord," Pumpherston, Mid-Calder, engineer. Registered office: 108, Douglas Street, Glasgow, C.2.

Gaskell & Garraway, Ltd.—Private company. Registered August 29th. Capital, £1,000 in 10s. shares. Objects: To acquire (1) the business of electrical and refrigerating engineers now carried on by J. C. P. Madden Gaskell and A. Garraway as "Gaskell & Garraway" at Bridge Street, Taunton; and (2) the business of a wireless engineer and dealer in wireless sets now carried on by J. C. P. Madden Gaskell at Bridge Street, Taunton. The directors are: J. S. Gaskell (chairman), Edmonstone, Southerndown, Bridgend; J. C. P. Madden Gaskell (managing director), Court Blethyn, Ruishton, Taunton; A. Garraway (managing director), 29, Addison Grove, Taunton. Secretary: J. C. P. Madden Gaskell. Registered office: Bridge Street, Taunton.

North Surrey Electrical Factors, Ltd.—Private company. Registered August 29th. Capital, £600 in £1 shares. Objects:—To carry on the business of engineers, manufacturers, importers and exporters of, agents for and dealers in all kinds of electrical and mechanical machinery, apparatus, lamps, accessories and fittings, wireless apparatus and accessories, cables and wires of all kinds, televisor apparatus, &c. The directors are:—Mrs. Mary W. Band, 59, Culmstock Road, S.W.11; C. F. Turner, 23, Hunter Road, Thornton Heath, Surrey.

John Lightfoot, Ltd.—Private company. Registered August 30th. Capital, £10,000 in £1 shares. Objects:—To acquire the business of an electrical engineer now carried on by J. Lightfoot at 94, Oxford Road, Manchester, as "John Lightfoot," and to carry on the business of electricians, electrical and mechanical engineers, &c. The directors are:—J. Lightfoot, "Broomfield," Ashton-on-Mersey, Cheshire; G. S. Mills, 11, Hartley Road, Chorlton-cum-Hardy, Manchester; Miss Olive Lightfoot and Miss Nora Lightfoot, "Broomfield," Ashton-on-Mersey, Cheshire. The said J. Lightfoot shall be permanent governing director and chairman so long as he holds £1,000 shares. Remuneration of permanent governing director, £1,000 per annum. Registered office: 94, Oxford Road, Manchester.

Hydraulic and Electrical Co., Ltd.—Registered August 28th. Capital, £12,500 in 1s. shares. Objects:—To adopt agreements with (1) T. L. R. Cooper, and (2) with R. E. Smart, and to carry on the business of mechanical engineers and manufacturers of motors, machinery, machine, electrical and other tools and implements of all kinds, iron and brassfounders, metal workers, iron and steel convertors, &c. The directors are:—T. L. R. Cooper, 10, Gordon Road, Ealing, W.5; R. E. Smart, "Dunrea," King's Avenue, Carshalton Beeches, Surrey (director of the Halliwell Furnace and Engineering Co., Ltd.). Secretary: E. C. Rudkins. Registered office: 40, Broadway, S.W.1.

Fielding & Catchpole, Ltd.—Private company. Registered August 28th. Capital, £2,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in all kinds of electrical goods and sundries and motor accessories and spare parts, &c. The subscribers (each with one share) are: W. E. Maddox, 146, Lessingham Avenue, Upper Tooting, S.W.17, clerk; W. Webb, 12, Wilna Road, Earlsfield, S.W., clerk. Solicitors: Soames, Edwards & Jones, Lennox House, Norfolk Street, Strand, W.C.2.

Burndept Wireless (1928), Ltd. — Public company. Registered August 30th. Nominal capital, £200,000 in 5s. shares. Objects: To acquire all or part of the business of wireless instrument manufacturers carried on by Burndept Wireless, Ltd., at Blackheath, S.E., and elsewhere, and to manufacture, assemble, erect, install, equip, maintain, repair, let on hire and deal in (wholesale and retail) all wireless, telegraphic and telephonic apparatus, valves, instruments, equipment and accessories, electrical, magnetic, and radio-active instruments, buildings for demonstrating these and literature relating thereto, &c., and to adopt agreements (1) with the said old company and its liquidator, and (2) with Johnson and Phillips, Ltd. The minimum cash subscription is seven shares. The directors are: C. W. Rooke, C.A., Beau Séjour, Hillcroft Road, Ealing, W.5 (chairman); T. A. Barson, Orchard Side, Parracombe, N. Devon; W. Horridge, Heather Lea, Bury, Lancs. (director of Bentinck Mills, Ltd.); W. H. Lynas, 1, The Oaks, Frognal, N.W.3 (director of British Pototone, Ltd.); A. F. H. S. Simpson, 3, Eaton Gate, S.W.1 (managing director of Oliver Typewriter Co., Ltd.). Qualification: £100. Remuneration: £250 each per annum (chairman £500). Solicitors: Herbert Smith & Co., 62, London Wall, E.C.2.

Cavendish Trading Co., Ltd.—Private company. Registered August 29th. Capital, £1,000 in £1 shares. Objects: To carry on business as electricians, manufacturers of wireless, telegraphs or telephones, generators, accumulators and apparatus, dealers in motor vehicles and accessories, &c. The first directors are: N. H. Colson, 73, Cromwell Road, Hove; J. W. Hall, 7, Dulwich Road, Herne Hill, S.E.24, electrical engineer; W. C. G. Stokes, 5, The Pavement, Clapham, S.W.4, electrical engineer. Registered office: 5a, Palace Chambers, Bridge Street, S.W.1.

Official Returns of Electrical Companies.

Midland Electric Corporation for Power Distribution, Ltd.—*Capital £1,000,000 in 800,000 ordinary and 200,000 preference shares of £1 each. Return dated April 4th, 1927, and allotments dated May 31st, 1928. 700,000 ordinary and 200,000 preference shares taken up. £484,605 paid on 134,605 preference and 350,000 ordinary shares, £415,395 considered as paid on 65,395 preference and 350,000 ordinary shares (the latter issued as "bonus" in May, 1928). Mortgages and charges at April 4th, 1927: £485,600. *Increased from £600,000 by creating 400,000 new ordinary shares in April, 1928.

United River Plate Telephone Co., Ltd.—Capital, £8,000,000 in 1,216,000 ordinary, 40,000 preference, and 344,000 unissued shares of £5 each. Return dated June 26th, 1928. 1,216,000 ordinary and 40,000 preference shares taken up. £6,200,000 paid on 1,200,000 ordinary and 40,000 preference shares. £80,000 considered as paid on 16,000 ordinary shares. Mortgages and charges, nil.

Llanelly and District Electric Supply Co., Ltd.—Capital, £500,000 in 250,000 preference and 250,000 ordinary shares of £1 each. Return dated April 17th, 1928. 250,000 preference and 200,000 ordinary shares taken up. £444,000 paid. £6,000 considered as paid. Mortgages and charges, £275,281.

D.P. Battery Co., Ltd.—Capital, £100,000 in £1 shares. Return dated May 31st, 1928. All shares taken up. £28,000 paid. £72,000 considered as paid. Mortgages and charges, nil.

Oxford Electric Co., Ltd.—Capital, £350,000 in 150,000 6 per cent. preference and 200,000 ordinary shares of £1 each. Return dated May 30th, 1928. All shares taken up. £1 per share called up on 150,000 preference and 66,000 ordinary shares and 12s. 6d. per share on 100,000 ordinary shares. £246,872 17s. 6d. paid, leaving £31,627 2s. 6d. calls unpaid. £34,000 considered as paid on 34,000 ordinary shares. Mortgages and charges, £110,000.

Electric Light and Power Contracts Finance Corporation, Ltd.—Capital, £10,000 in 19,000 preference shares of 10s. each and 10,000 founders' shares of 1s. each. Return dated December 31st, 1927 (filed May 29th, 1928). 10,182 preference and 2,264 founders' shares taken up. £5,748 9s. paid (including premium on founders' shares). Mortgages and charges, £50,000.

Richmond (Surrey) Electric Light and Power Co., Ltd.—Capital, £200,000 in £1 shares. Return dated May 17th, 1928. All shares taken up. £200,000 paid. Mortgages and charges, nil.

Sunray, Ltd.—Capital, £2,000 in £1 shares. Return dated June 23rd, 1928. All shares taken up. £2,000 paid. Mortgages and charges, nil.

Loch Leven Electricity Supply Co., Ltd.—Capital, £10,000 in £10 shares. Return dated March 27th, 1928. 500 shares taken up. £5,000 paid. Mortgages and charges, nil.

Tisbury Electric Supply Co., Ltd.—Capital, £6,000 in £1 shares. Return dated May 24th, 1928. All shares taken up. £6,000 paid. Mortgages and charges, nil.

Dudley, Stourbridge and District Electric Traction Co., Ltd.—Capital, £200,000 in 20,000 preference and 20,000 ordinary shares of £5 each. Return dated May 9th, 1928. All shares taken up. £200,000 paid. Mortgages and charges, £103,140.

New Union Electric Co., Ltd.—H. A. Leach, C.A., of Windsor House, Victoria Street, S.W.1, was appointed receiver on August 27th, under powers contained in debenture dated January 4th, 1928.

Dartmoor Electric Supply Co., Ltd.—T. W. W. Melhuish, 21, St. Leonards Road, Exeter, ceased to act as receiver on August 22nd, 1928.

Nelson Engineering Co., Ltd.—Satisfaction in full on August 22nd, 1928, of mortgage dated December 29th, 1921, securing £350.

Wellings & Co., Ltd.—Mortgage dated October 6th, 1920, to secure £600, charged on the Rose Cottage Works, Newhampton Road, Wolverhampton, with fixtures, &c. Holders: Mrs. E. Wells, 20, Oakwood Court, Kensington, W., and S. W. Page, solicitor, Wolverhampton. (Registered August 20th, 1928, by permission of the Court.)

Nico Light Co., Ltd.—Satisfaction in full on February 15th, 1928, of debenture dated July 16th, 1920, securing not more than £30,000.

Kitson's Insulations, Ltd.—Capital, £7,500 in 5,000 preference shares of £1 each and 5,000 ordinary shares of 10s. each. Return dated December 31st, 1927 (filed April 20th, 1928). 5,000 ordinary shares taken up. £1 paid, £2,499 considered as paid. Mortgages and charges: £5,000.

Hulton & Hinchliffe, Ltd.—Capital, £500 in £1 shares. Return dated February 27th, 1928. All shares taken up. £500 paid. Mortgages and charges, nil.

Singapore Traction Co., Ltd.—Capital, £400,000 in 200,000 preference, 199,999 ordinary, and one management share of £1 each. Return dated February 22nd, 1928. 200,000 preference, 165,208 ordinary, and one management share taken up. £7 paid, £365,202 considered as paid. Mortgages and charges: £200,000.

Power Development Co., Ltd.—Capital, £22,000 in 20,000 6 per cent. cumulative preference shares of £1 each and 40,000 ordinary shares of 1s. each. Return dated June 21st, 1928. 17,500 preference and 30,000 ordinary shares taken up. £11,500 paid on 10,000 preference and 30,000 ordinary shares, £7,500 considered as paid on 7,500 preference shares. Mortgages and charges, nil.

Woodfyt Sales, Ltd.—Capital, £2,550 in 1,000 preference and 1,550 ordinary shares of £1 each. Return dated December 31st, 1927 (filed February 25th, 1928). 484 preference and 205 ordinary shares taken up. £689 paid. Mortgages and charges, nil.

Giljay, Ltd.—Capital, £1,000 in £1 shares. Return dated December 31st, 1927 (filed April 16th, 1928). 975 shares taken up. £801 paid, £174 considered as paid. Mortgages and charges, nil.

Electrical Power Engineering Co. (Birmingham), Ltd.—Capital, £5,000 in £1 shares. Return dated November 2nd, 1927 (filed April 21st, 1928). 2,445 shares taken up. £1,100 paid, £1,345 considered as paid. Mortgages and charges, nil.

A. Rist (1927), Ltd.—Mortgage on Waveney Works, Freemantle Road, Lowestoft, dated July 31st, 1928, to secure £8,000. Holder: D. A. V. Rist, "Avonholme," Park Estate, Oulton Broad, near Lowestoft.

Pontypool Electric Light and Power Co., Ltd.—Issue on August 10th, 1928, of £300 debentures, part of a series already registered.

Electricals, Ltd.—Debenture bond dated August 14th, 1928, to secure £2,000, charged on the company's undertaking, property and assets, including uncalled capital. Holder: R. C. Taylor, Consett Chambers, Pilgrim Street, Newcastle-on-Tyne. (The £2,000 is to be paid in consideration of the guarantee of £1,000 to the bank.)

Electromonic Co., Ltd.—Land Registration Charge on freehold land at Bear Gardens, Southwark, dated March 24th, 1928, to secure £15,000. Holders: F. E. Newman and J. V. Newman, Rose Alley Street, S.E.1. (Registered July 31st, by permission of the Court.)

W. T. Glover & Co., Ltd.—Capital, £214,850 in 100,000 preference and 114,850 ordinary shares of £1 each. Return dated April 10th, 1928. All shares taken up. £117,000 paid. £97,850 considered as paid. Mortgages and charges, nil.

Eastern and South African Telegraph Co., Ltd.—Capital, £600,000 in £10 shares. Return dated July 26th, 1928. All shares taken up. £600,000 paid. Mortgages and charges, nil.

Holywern and District Electricity Supply Co., Ltd.—Capital, £1,000 in £1 shares. Return dated May 19th, 1928. 500 shares taken up. £500 paid. Mortgages and charges, nil.

Gayton Park Electricity Co., Ltd.—Capital, £3,000 in £1 shares. Return dated December 31st, 1927 (filed March 8th, 1928). All shares taken up. £3,000 considered as paid. Mortgages and charges, nil.

Premier Accumulator Co. (1921), Ltd.—Capital, £40,000 in £1 shares. Return dated July 24th, 1928. All shares taken up. £18,749 paid (£1 on 11,249 and 15s. on 10,000). £18,751 considered as paid on 18,751 shares. Mortgages and charges, nil.

Siemens Bros. & Co., Ltd.—Capital, £3,000,000 in 2,450,000 ordinary and 550,000 10 per cent. cumulative preference shares of £1 each. Return dated June 4th, 1928. 2,000,000 ordinary and 550,000 preference shares taken up. £2,550,000 paid. Mortgages and charges, £757,700.

Howard Asphalt Troughing Co., Ltd. (formerly Howard Conduit Co., Ltd.). Capital, £20,000 in 19,000 ordinary and 1,000 deferred shares of £1 each. Return dated May 15th, 1928. 5,007 ordinary and 1,000 deferred shares taken up. £4,007 paid. £2,000 considered as paid. Mortgages and charges, nil.

Yorkshire Switchgear and Engineering Co., Ltd.—Capital, £10,000 in £1 shares. Return dated May 2nd, 1928. 5,382 shares taken up. £2,382 paid. £3,000 considered as paid. Mortgages and charges, £4,151 7s.

Alliance Electrical Co., Ltd.—Capital, £10,000 in £1 shares. Return dated May 28th, 1928. 3,854 shares taken up. £1,927 paid (10s. per share). £1,927 considered as paid (10s. per share). Mortgages and charges, nil.

City Notes.

General Electric Co., Ltd.

Following upon the remarks of Sir Hugo Hirst regarding the possibility of foreign control at the last annual meeting (*vide* ELECTRICAL REVIEW, July 13th, p. 71), an extraordinary general meeting has been called for to-day (Friday) to consider resolutions guarding against this danger. In view of the novel and interesting nature of the proposed alterations of the company's articles of association we reproduce the resolutions *in extenso* below :—

1. That the Articles of Association of the company be altered in the manner following, that is to say :—

(1) By adding to article 1 the following :—

The expression "Foreigner" means any person who is not a British subject and the expression "Foreign Corporation" means any corporation other than a corporation established under and subject to the laws of some part of His Majesty's Dominions and having its principal place of business in those dominions. The expression "Corporation under Foreign Control" includes :—

(*a*) A corporation of which the majority of the directors or persons occupying the position of directors by whatever name called are foreigners.

(*b*) A corporation, shareholders in which holding shares or stock conferring a majority of the votes are foreigners or foreign corporations or persons who hold directly or indirectly for foreigners or foreign corporations.

(*c*) A corporation which is by any other means, whether of a like or of a different character, in fact under the control of foreigners or foreign corporations.

(*d*) A corporation the executive whereof is a corporation within (*a*), (*b*) or (*c*).

(2) By inserting under the heading of "Votes of Members" immediately before Article 77 the following new Article :—

76a. No vote shall be given at any general meeting of the company by a foreigner or foreign corporation or corporation under foreign control or by any person who holds the shares in respect of which he proposes to vote directly or indirectly for a foreigner or a foreign corporation or a corporation under foreign control. In any case of doubt as to whether a vote has been validly given or is validly tendered having regard to the provisions of this article, the directors shall be entitled to call on the person giving or tendering such vote to prove to their satisfaction that the shares in respect of which such vote is given or tendered are not so held and in default of such proof being given to the satisfaction of the directors the vote so given or tendered shall be rejected and ignored. A majority of the directors may also at any time certify in writing that there is in their opinion reason to believe that any share in the company is held by or in trust for or is under the control of a foreigner or foreign corporation or corporation under foreign control and thereupon the directors shall call on the holder of such share to prove to their satisfaction that the share in question is not so held and as from the time when any such certificate as aforesaid is signed up to the time when such proof as aforesaid is given the share referred to in such certificates shall not confer on the holder any right to vote. The succeeding Articles numbered 77 to 86 (both inclusive) shall be read subject to this Article.

(3) By adding to Article 87 the following words namely :—Provided that a majority of the directors shall be British subjects.

The resolutions have been approved by the Stock Exchange Committee.

East African Power and Lighting Co., Ltd.

The profit for the year ended December 31st, 1927, amounted to 822,025 shillings, and the addition of 24,954 sh. brought forward makes 846,979 sh. available. After meeting interest on notes (now repaid) and transferring 125,261 sh. to general reserve and 180,839 sh. to depreciation account, a dividend at the rate of 7 per cent. is paid on the instalments paid on the cumulative preference shares and 6 per cent. on the ordinary shares. A balance of 30,966 sh. is carried forward. During the year the 7 per cent. three-year notes were redeemed and an issue was made of 270,000 7 per cent. cumulative preference shares of 20s. each. A premium of 270,000 sh. on the issue has been carried to the general reserve.

English Electric Co., Ltd.

The directors announce that they are again unable to recommend the payment of an interim dividend on the 6 per cent. preference shares. The dividend on these shares is now in arrear from July 1st, 1926.

Hurst, Nelson & Co., Ltd.

A dividend of 2s. per share, plus 6d. bonus, has been declared on the ordinary shares, as in 1927.

Rangoon Electric Tramway and Supply Co., Ltd.

An interim dividend of 8 annas per share, free of Indian income tax, has been declared on the ordinary shares, as in 1927.

Columbia Gas and Electric Co.

The total net earnings rose from $32,772,870 for 1926-27 to $35,043,285 for the year ended June 30th last, while the net income increased from $23,616,950 to $26,194,993.

Sociedad Anonima Cia. de Tramways Electricos del Sud.

The profit for the past year was $48,702; this is added to a balance of $190,719 brought forward, making $239,421. After meeting various expenses the available balance is $208,906, which is dealt with as follows: Dividend of 3 per cent., $118,979; to renewals fund, $40,000; carried forward, $49,927.

Brazilian Traction, Light and Power Co.

A quarterly dividend of 1¼ per cent. has been declared on the cumulative preference shares.

Clarke, Chapman & Co., Ltd.

An interim dividend of 3 per cent. (against 2 per cent. last year) has been declared on the ordinary shares.

Canadian General Electric Co.

The dividend in respect of the quarter ending September 30th has been declared on the preference stock.

Czecho-Slovakian Company.

The *Pressburg Cable Works Company*, Pressburg, records net profits of 5.87 million Czech crowns for 1927-28, as against 5.19 millions in the preceding year, and the dividend remains at 22 per cent.

Austrian Company.

The *Cable and Wire Industry Company*, Vienna, reports net profits of 610,000 schillings for 1927-28, as compared with 420,000 sch. in the previous year. The company's principal business during the year was the delivery of cables for the Postal authorities and the Federal Railways, and h.p. cable to the city of Vienna. It is proposed to pay a dividend of 13½ per cent., as against 10 per cent. in 1926-27.

Stocks and Shares.

MONDAY EVENING.

HOLIDAYS have now come so nearly to their end that Stock Exchange markets may be said to have entered upon their more or less normal course again. Business is active in certain markets. There continues to be a lively attention shown to electrical issues of various kinds. In the supply section, a mild reaction occurred amongst some of the shares that lately enjoyed substantial rises. The Latin-Canadian group is decidedly higher. Cable stocks have taken another upward turn. Marconis are the centre of a very brisk business. Manufacturing shares show pronounced improvement. Underground Electrics are an outstanding feature of strength in the Home Railway market.

Eastern Stocks Advance.

Buying pressure applied to cable stocks served to lift Eastern Telegraph ordinary to 250, a gain of 5 points. In sympathy, Eastern Extensions, Westerns and Globes are 5s. to 15s. higher, the first-named attracting the major amount of interest. The companies, it is understood, are pursuing a vigorous policy of economy, cutting down expenses in all directions where this can be done without sacrifice of efficiency. Eastern ordinary at 250 and the other three companies' shares at 25 all yield 4 per cent. net on the money, on the basis of the 10 per cent. tax-free dividends which have been paid for some years past. The prior-charge stocks may be said to have reached the dignity of gilt-edged securities. Eastern 3½ per cent. preference at 69 and the 4 per cent. debenture at 80½ return a shade over, and under 5 per cent. respectively. The "China" and the Western Companies' 4 per cent. debenture stocks are quoted at a similar figure.

Other Cables Strong.

In addition to the advances exhibited by the Eastern group, improvements have been secured by other cable stocks and shares. Anglo-American 6 per cent. preferred at 103½ and Great Northern Telegraph shares at 38½ are 10s. up. Indo-Europeans put on £1, to 46½. American Telephone and Telegraph capital stock rose to 184½. Nothing more has been heard, by the way, of a singular rumour, current a fortnight ago, to the effect that an American organisation contemplated competition with the Eastern cable companies. Commercial Cable 4 per cent. debenture stock is changing hands on the basis of 77. A serious-faced broker asked in the market for the amount that should be added to the yield per cent. on the stock as allowance for redemption at its due date of 2397.

Marconis.

Marconis furnish one of the daily excitements in the Industrial market. Optimism waxes high in regard to the outlook, and the price of the shares was run up to 69s. 6d., from which it gave way a trifle, remaining 2s. 6d. higher on balance. The company's 6½ per cent. convertible debenture stock has now been removed from quotation in the Stock Exchange Official List, a strong hint that holders should on no account neglect to seize their opportunity for converting their bonds into the £1 shares. Friday in this week is the latest time at which this can be done, and proprietors who have not sent in their conversion forms should do so immediately. Each £100 debenture is convertible into 33 shares of

£1 each, which are quoted at 47s. 8d., and worth, therefore, £160. But for unconverted debentures the company will pay only £105 on October 1st. Marconi Marines parted from 6d. of their recent gain. Canadian Marconis shot up to 31s. on Montreal support.

Electricity Supply.

North Metropolitan ordinary shares have risen to 47s. 9d., and Northampton Electrics remain a good market at 42s. 6d., showing a small gain on the week. County of London went over £2, the market being poorly supplied with shares to meet a good deal of demand. South Londons, in the same group as County of London, hardened to 27s. London Electrics recovered the dividend taken off the price last week. Egham and Staines are 39s. for the old, and 38s. for the new shares. Scottish Power new ordinary eased off to 37s. premium, without, however, affecting the price of the previous issue, quoted at 33s. The tendency of the market as a whole is a shade less firm, although references to our price-lists will demonstrate how well the lighting shares hold the strength gathered during the past few weeks.

Big Mexican Rises.

By far the most substantial improvement is that shown by Mexican Light and Power common shares. These have put on 16 points, to 87, the reason being an accession of buying orders largely from the Continent. Local support has also been in evidence, and other Mexican descriptions have shared, though less dramatically, in the movement. Mexican Light and Power second preference went up to 2⅞. Mexico Tramways have advanced 3, to 40½, making a gain of 7½ points within a fortnight. It is a little singular that the bonds of the utility companies have not moved. It is still more singular that, in the case of brigandage reported from Mexico, the bandits are said to have returned half the spoils which they took from their victims.

Dollar Stocks.

After Mexican Light and Power shares, Brazilian Tractions' rise of 4 points may appear modest. Here, also, much of the motive power for the advance is said to come from Brussels. The dollar stocks continue to mount. Montreal Light and Power at 107 are 3 better; Shawinigan Water at 92½, Calgary Power fives at 96½, and Winnipeg Electric fives at 91¼ are about 2 points up in each case. These last-named movements are due to the re-entry of Canada as a buyer into markets where, for a few weeks after the death of Mr. Alfred Loewenstein, Montreal and other Dominion cities turned sellers. From this change of front it would appear that financial conditions in Canada have recovered from the effects of the shock occasioned by the tragedy.

South Wales Power.

Investment casts a wide net in its search for stocks and shares. The two classes of Adelaide Electric preference shares, the 6 per cents., and the tax-free 5 per cents. have risen to 21s. 6d., which is ex the dividends just paid. Madras Electric ordinary are better at 34s. 6d. Atlas Light and Power 7 per cent. preference strengthened to 22s. 6d. In the home provincial issues, Shropshire and Worcestershire ordinary are better at 35s. 7½d. South Wales Power ordinary stock, not often seen in the London market, aroused a little interest on account of there being a few thousand pounds offered at 75. No dividend is paid at present on the stock, but the chairman at the last meeting hinted at the possibility of a distribution being made in the reasonably near future. The stock falls into the category of a lock-up speculative investment.

British Control.

General Electrics have gone ahead to 41s. Widespread interest is aroused in the steps which the company proposes to take for the retention in British hands of the control of the undertaking. It is clear that the board must deem that the possibility of this control passing into other than British hands is not to be lightly considered, and there will be a hearty endorsement of the determination to keep this important company under British direction. Readers of the ELECTRICAL REVIEW need no reminder of the frequently-repeated Stock Exchange rumours that certain electrical companies have been for a long time past the object of American desire. No doubt the General Electric's action will be followed by similar steps on the part of other undertakings.

Miscellaneous.

British Aluminium shares have gone ahead to 46s. 3d., a rise of 1s. 9d. Brush ordinary rose a few pence to 28s. 9d. Metropolitan-Vickers ordinary at 33s. 9d. are again higher on account of the good orders which the company is securing. Telephone Manufacturing are dullish at 6s. 3d. Anglo-Portuguese Telephones keep steady at 24s.: the company and the Portuguese Government have satisfactorily settled their agreement under which the former now enters upon its new concession for a period of 40 years. Bogota Telephone old shares are 32s. 6d.; the new, 29s. 6d. The iron, engineering and allied shares are better. Vickers have risen to 13s. Babcocks are a good market at 67s. 6d. The rubber outlook continues obscure, and the price of the raw produce has dwindled, leading to losses in the case of a good many rubber companies' shares.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1926.	Dividend. 1927.	Price Sept. 3, 1928.	Rise or fall.	Yield. p.c.
	£					
Bournemouth and Poole	1	14†	15	3¼	—	... ...
Brompton Ordinary	1	8⅝	8½	27/-xd	+9d.	5 3 8
Charing Cross Ordinary	1	8½	8½	27/-	—	5 3 8
do. do. 4½% Pref. ...	1	4½	4½	17/6	—	5 2 10
Chelsea	1	8⅝	8⅝	27/6	—	5 1 10
City of London	1	10	10	33/3xd	+1/-	4 4 4
do. do. 6% Pref.	1	6	6	23/-xd	—	5 4 4
Clyde Valley	1	8	8	37/6	—	4 5 3
County of London	1	7½	7½	40/6	+2/-	3 14 3
do. do. 6% Pref.	1	6	6	23/6	—	5 2 2
Edmundsons' 7% Pref.	1	7	7	25/6	—	5 9 10
Elec. Supply Corporation	1	11	11	2¾	—	4 8 0
Kensington Ordinary	1	8	8	26/6	—	5 5 8
Lancs. Light and Power	1	7½	7½	30/-	—	5 0 0
London Electric	1	8½	8½	27/6xd	+6d.	5 1 10
Metropolitan	1	8	9	48/3	—6d.	3 13 9
do 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	6	6¼	31/6	—	4 2 6
Mid. Elec. Power	1	—	15	43/9	—	... ...
Newcastle-on-Tyne Ordinary ...	1	5	6	25/9	—	4 13 2
do. 7% Pref. ...	1	7	7	27/-	+6d.	5 3 8
Notting Hill 6% Pref.	10	6	6	10⅝	—	5 11 7
North Met. Elec. 6% Pref.	1	6	6	23/-	—	5 4 4
St. James' and Pall Mall	5	8	8	27/6	—	5 1 10
Scottish Power	1	8	8	33/-	—	4 17 0
South London	1	8½	8½	27/-	+6d.	5 3 8
Urban Ordinary	1	7	7	35/-	—	... ...
Westminster Ordinary	1	8½	8½	27/-	—	5 3 8
Whitehall Elec. Invst. 7½% Pref....	1	7½	7½	24/-	—	6 5 0
Yorkshire Elec.	1	8	8	36/-	—	4 9 0

HOME RAILS.

Central London Ord. Assented ...	Stock	4	4	72xd	+½	5 11 1
Metropolitan	,,	3	3	66½	—	4 10 3
do. District	,,	3½	4	79½	+½	5 0 8
Underground Electric	£1	1½	5	27/-xd	+6d.	3 14 1
do. do. Income ...	Bonds	6	6	129xd	+1½	4 13 0

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	103½	+½	5 16 0
do. Def.	,,	1½	1½	24½	—	6 3 9
Automatic Telephone	1	10	10	43/9	—	4 9 0
Eastern Extension	10	10	10	25	+⅜	*4 0 0
Eastern Tel. Ord.	Stock	10	10	250	+10	*4 0 0
Globe Tel. and T. Ord.	10	10	10	24½	+¼	*4 1 8
do. do. Pref.	10	6	6	11½	—	5 7 10
Great Northern Tel.	10	20	20	38½	+⅛	5 4 0
Indo-European	25	10	10	46½	+1	*5 7 6
Marconi	10/-	5	*10	3 7/16	+⅛	... ...
Marconi-Marine	1	8½	12½	50/6	—6d.	4 19 0
Oriental Telephone Ord.	1	12	12	56/3	—	*4 5 3
United R. Plate Tel.	5	8	8	9⅞	+⅛	*4 1 0
Western Telegraph	10	10	10	24½	+¼	4 1 8

*Interim.

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	5½	3⅜	—	7 11 9
do. do. 2nd. Pref. ...	5	6	6	3½	—	8 11 6
do. do. 5% Deb. ...	Stock	5	5	78½	—	6 7 5
British Electric Traction Def. Ord.	,,	—	—	520	—	... ...
do. do. Pref. Ord.	,,	8	7½	125	—	6 0 0
Brazil Traction	100	6	7	60½	+4	2 17 10
Brit. Colombia Elec. Rly. Pcc. ...	Stock	5	5	90½	—	5 3 9
London & Sub. Trac. 5% Pref. ...	1	Nil	Nil	10/6	—	... ...
London United Tram Deb. ...	Stock	4	4	60½	—	6 12 3
Mexico Trams, 5% Bonds	—	5	5	79	—	6 6 7
Mexican Light Common	100	Nil	Nil	87	+16	... ...
do. 7% Pref....	100	Nil	7	77½	—	9 0 8
do. 1st Bonds	—	5	5	80½	—	6 4 3
Yorkshire (West Riding)	1	Nil	Nil	5/-	—	... ...

MANUFACTURING COMPANIES.

Babcock & Wilcox	1	13	15	67/6	—	*4 9 0
British Aluminium Ord.	1	10	10	46/3	+1/9	*4 6 7
British Elec. Transformer Pref....	1	7	7	18/-xd	+6d.	7 15 0
British Insulated Ord.	1	15	15	4¾	—	3 10 6
Brush Ord.	1	10	10	28/9	+6d.	6 19 2
Callenders	1	15	15	4¾	—	3 12 6
do 6½% Pref.	1	6½	6½	23/9	—	5 9 5
Crompton Parkinson Pref Ord. ...	1	—	6	17/6	—	6 17 2
do. 8% Pref.	1	—	8	26/3	—	6 2 0
Edison-Swan	4/-	10	10	12/6	—	3 4 0
do. 5% Deb.	Stock	5	5	88	—	5 13 8
Electric Construction	1	7½	7½	27/6	—	5 9 1
Enfield Cable Ord.	1	20	20	4⅜	—	4 11 6
English Electric	1	Nil	Nil	7/6	—	... ...
do. do. Pref	1	3	Nil	10/-	—	... ...
Gen. Elec. Pref.	1	6¾	6¾	24/6	—	5 6 1
do. Ord.	1	7½	10	41/-	+6d.	4 17 7
Henley	1	25	25	5½	—	4 11 0
do. 4½% Pref.	5	4½	4½	41xd	+1/9	5 6 0
India-Rubber	1	Nil	Nil	13/9	—	... ...
Johnson & Phillips	1	12½	10	2	—	5 0 0
Met.-Vickers Ord.	1	8	6	33/9	+6d.	3 11 3
do. Pref.	2	8	8	2⅜	—	6 1 11
Siemens Ord.	1	7½	7½	28/9	—	5 4 4
Telegraph Construction	12	10	10	24½	—	*4 18 6

*Dividends paid free of Income Tax.

†4% of which was tax free.

The British Association—I.

The Glasgow Meeting.

THIS year is a special one in the 98 years which have passed since the foundation of the British Association for the Advancement of Science, for in March last a charter of incorporation was granted to the Association. The place chosen for this year's meeting is Glasgow, a city which has welcomed the Association on four previous occasions, the last being in 1901, when the then Secretary of the Royal Society, Sir Arthur Rücker, was president.

Sir William H. Bragg, K.B.E., &c. is the president for the ensuing year, and he delivered his address on "Craftsmanship and Science" at the inaugural general meeting in St. Andrew's Hall on Wednesday evening last. An abstract of the address follows these notes.

A portrait of Sir William Bragg is reproduced herewith. The new president is extremely well known in the electrical world for his fundamental researches into radio-activity. For this work he has received many honours from British and foreign academies and institutions. In 1915 he and his son, Mr. W. L. Bragg, were awarded the Nobel Prize for work on X-rays and crystal structure. In addition to many other activities, he has been director of the Davy-Faraday Research Laboratory since 1923. Sir William was born in 1862, and he spent a great part of his younger days in Australia; he was a professor at Adelaide University from 1886 to 1908, and a member of the University Council.

Lafayette] *[London.*

Sir William H. Bragg, K.B.E., D.Sc., F.R.S., &c.
President of the British Association, 1928-29.

Electricity does not play a very prominent part in the proceedings of Section G—Engineering this year, although on Tuesday next the morning is devoted mainly to electrical papers. The principal one will be "The Possible Application of High-Frequency Power to Electric Traction," by Prof. W. Cramp, D.Sc. The author will present some results of work on this fascinating subject which has been carried out under his guidance in the University of Birmingham, where he is Professor of Electrical Engineering. Mr. B. Hague is to present a paper on "Experimental Methods for Determining the Distribution of Electric and Magnetic Fields," and this will be followed by a further study of "The Jet Wave and its Applications," by Dr. J. Hartmann. At the Leeds meeting last year, Dr. Hartmann described this form of rectifier in some detail. The essential part of the apparatus is a jet-wave commutator, the main component of which is one or more wave-shaped mercury jets. At that time single-jet commutators for 30-40 kW at about 180 V d.c. had been developed, and they had been employed in series for higher capacities and voltages. This year Dr. Hartmann will presumably deal with further developments which have evolved from the work which is being carried out at the Royal Technical College, Copenhagen, and the municipal power station of that city.

On Wednesday next the report of the Committee on Electrical Terms and Definitions will be presented, and papers will be read by Professors G. W. O. Howe, C. L. Fortescue and E. W. Marchant.

Yesterday (Thursday) was to be devoted mainly to a joint discussion with Section L—Education, upon "School, University, and Practical Training in the Education of the Engineer," a subject which has been very prominent recently. Col. Ivor Curtis, C.B.E., was to describe the Air Force apprenticeship system and to appeal to the universities to modify their long-established practice of providing facilities for only the scholarly type of mind, to meet the needs of practical-minded men. In the afternoon an excursion to the Falls of Clyde hydro-electric station (Clyde Valley Electrical Power Co.) was arranged.

The presidential address of Sir William Ellis, G.B.E., "The Influence of Engineering on Civilisation," was to be read this (Friday) morning, it being followed by two papers:—"Recent Developments in High-Pressure Boilers," by Mr. H. E. Yarrow, and "An Investigation into the Throat Conditions during the Adiabatic Flow of Mercury Vapour through Nozzles," by Mr. W. J. Kearton. Monday is to be devoted to four papers dealing with internal-combustion engines.

In Section A—Mathematical and Physical Sciences—there are several papers of an electrical nature. Prof. A. W. Porter's presidential address is entitled "The Volta Effect," and he discusses the reasons for the flow of electricity between different metals and thermoelectric phenomena, especially in the light of the development of our knowledge of the electron. The electrical state of the atmosphere is one of the matters before the Section. There was to be a discussion on "The Mechanism of Thunderstorms," yesterday, in which several well-known meteorologists were to take part, including Dr. R. A. Watson-Watt, who is to read a paper on "The Present State of Our Knowledge of Atmospherics" on Monday. On the same day Mr. A. H. R. Goldie is to present a study of "Magnetic Storms." Other papers to be read in the Section include "Frequency Variations of the Triode Oscillator," by Mr. D. F. Martyn, "Some New Experiments on Supra-conductors," by Prof. W. J. de Haas, and "The Condenser Telephone," by Dr. G. Green.

The questions of rationalisation and standardisation in industry are to receive attention in Section F—Economics, at the hands of Major L. Urwick and Mr. C. Le Maistre respectively.

Craftsmanship and Science.

By Professor SIR WILLIAM BRAGG, K.B.E., D.Sc., F.R.S.

(Abstract.)

In the last few years scientific inquiry has advanced at a rate which to all is amazing, and to some is even alarming. The application of science to industry has become increasingly important and obvious, especially at the present time, when our country is struggling to free itself from distress due partly to the war and partly to violent changes in economic conditions; and in the less material realms the applications of recent research have aroused wide interest.

I propose in speaking of "craftsmanship and science" to pay attention more particularly to the relations between science and the craftsmanship of our own country. By the term "craftsmanship" I mean the skill which is exercised in the production of whatever is wanted for human welfare. It embraces knowledge of materials, imagination, technical skill; perseverance is wanted, love of the work itself, sympathy with the use that is to be made of it, and with the user. It is not only that the products of craftsmanship are a necessity: craftsmanship has a value in itself. It is a fact that love of good work and delight in successful accomplishment are powerful motives, and when satisfied are sources of real happiness. A people lives on what it makes or earns, and its success depends on its craftsmanship.

The craftsmanship of a people is an expression of the best of its very self. The mind of a nation is so expressed because its craftsmanship, interpreted in its widest sense, represents its efforts to live. Under this strong compulsion the nation produces results which range from pots to poetry, and all its products are stamped alike. Even if we consider it only in relation to the production of material things, the state of a nation's craftsmanship is an index of its health.

As a people departs from its primitive condition so also does its craftsmanship. The craftsman becomes an association of men; many hands, working in an alliance which is often unconscious, are employed in bringing a product to its finished form. It is a long step from the simple workshop of the old single-handed craftsman to the vast complex factory of modern industry. If, now, we ask what has brought us to this new kind of modern craftsmanship, this dependence on machinery with its wealth of production, and its compelling influence on the lives of all of us, we find that one simple cause has been continuously operative: it is nothing more or less than the urgent wish of the individual to better his own condition—and in his disinterested moods, the condition of his neighbours. The change could never have been prevented.

The results have to be accepted. The plain truth is that modern craftsmanship with all its noise and ugliness is giving food and clothing, warmth and interest, to millions who otherwise must die. It is ungrateful to find fault except with sympathy. Let us try in all possible ways to mend its offences and soften its hardships, but in all honesty let us recognise that we live on craftsmanship in its modern form.

Now I would draw your attention to the manner in which, under the urgent drive of self-preservation, the craftsman has called scientific knowledge to his aid. When, for example, coal mining was at a low ebb because the mines were becoming waterlogged and no available power was strong enough to clear them, Savery and Newcomen made use of the new discoveries respecting the pressures of gases and vapours which Torricelli and Pascal, Papin and Hooke, had just been examining and trying to explain. The steam engine thus came into being and saved the situation. And when, in 1831, Faraday, in the course of certain systematic searchings, found out the way in which one electric current could bring another into being, the so-called electromagnetic induction; with that single day's work began the whole development of electrical engineering in its innumerable forms.

More often it happens that scientific knowledge enters with less instantaneous and startling effect into the history of a craft. It is only when you come to consider the various details of some modern product of craftsmanship that you realise how closely every detail is connected with the advance of science, and indeed, to be more particular, with the scientific laboratory.

If you hinder the growth of science in any way you hinder the growth of craftsmanship. Now it is an important fact that science advances over a wide front, and the various branches of it move on together. No one knows what is over the hill. The vanguard moves on without any thought of what is before it. That is why, if the march of science is to be conducted in an effective and orderly way, were it only for the purposes of industry, there must always be a certain number of laboratories or parts of laboratories where scientific research has no immediate thought of possible applications.

The closeness of the connection between craftsmanship and science may be illustrated in another way. It is a remarkable fact that the most active of our modern industries are those which are founded on recent scientific research. The most notable is, of course, that of electrical engineering. The year that sees the celebration of our Association's centenary will witness also the ceremonies that commemorate the basic experiment of Faraday. It is difficult to sketch in a few words the great edifices that have been built upon the discovery of electromagnetic induction. Think for a moment of the change in our lives if every electric current ceased to run: the whole mechanism of modern intercourse would fail, and populations born to use it would be brought to dire distress.

Though the electrical engineering industry with all its branches may be said to have its source in a single laboratory experiment, yet it has grown by the continuous adaptation of fresh streams of knowledge. The huge American corporations maintain research laboratories costing millions of pounds annually, and find that the financial return justifies their policy. The electrical industry was not merely launched by a single discovery; it is continually guided, strengthened, and extended by unremitting research.

If craftsmanship, to fulfil its task of providing for the people, must be continually improving its processes, then the nation that is to be successful must possess the means and the will to improve, and here we come, I think, to a notable point. May it not be said that in this country the means exist even to a remarkable degree? Our craftsmen as a whole, including all grades, are possessed of qualities, intelligence, skill, accuracy, and so on, which make improvement possible. Should it not, therefore, be our policy to take advantage of our country's qualities by continually seeking for fresh industries or fresh adaptations of the old? We should not cling unduly to older activities when they have reached the stage in which many others have learnt to do them with equal efficiency, and when we can go on to something new and, it may be, more difficult. Clearly the best protection of all is the knowledge and skill which can enable us to produce what others must ask us for because they cannot make it so well themselves.

These considerations lead naturally to a second aspect of the relations between craftsmanship and science. The improvement of craftsmanship depends in large part on the absorption and adaptation of scientific discovery. How is the process to be encouraged? We here come to a point which must be emphasised with all possible vigour, because its importance is not always realised. Scientific knowledge and experience if it is to be of full service must be in direct practical contact with the problem that is to be solved. If you have expert knowledge on any subject and your advice is asked, your first instinct is to ask to be allowed to see for yourself. It is only when all the circumstances are clear to you in their relation to the difficulty that the solution is likely to suggest itself. And it may take much watching and patient observation before you are successful. It is the combination of actual experience with scientific knowledge that is essential.

Are we, in this country, putting our scientific knowledge into the position where it is really effective? I would draw your attention to a most interesting and important movement which is attaining a notable magnitude. A new class of worker is growing up among us consisting of the men engaged in research associations and industrial research laboratories throughout the country. We must place a high value on their services, for they are actually and personally bringing back with them into craftsmanship the scientific knowledge which is one of its essentials. They bring the interest and the outlook of scientific inquiry into touch with both employer and employed, and I cannot but think that they may be to some extent the flux that will make them run together; for they can speak with the employer as men also trained in University and College, exchanging thought with ease and accuracy, and, at the same time, they are fellow workers with those in the shops and can bring back there some of the interest and enthusiasm which spring from the understanding of purposes and methods. Personal contact has, on the whole, thanks to the better qualities in human nature, a marvellous effect in smoothing out differences. I do not think it is unduly optimistic to welcome the growth of this new type of industrial worker because it can, being in personal intercourse with both capital and labour, supply to each a new outlook on their whole enterprise, especially as that outlook is naturally illuminating and suggestive.

The present number of industrial research workers is relatively small; it seems likely to increase, however, in proportion to the extent to which the province of science is better understood. The better understanding in industry itself is happily on the increase. There is also a broader view to be taken. There is a public estimation of the value of any calling which affects the numbers and the quality of those who respond. When it is realised that this kind of work is wanted badly, that it is really serviceable to the community, that there is opportunity for devotion, that it is in touch at once with human needs and with the furthest stretches of thought and imagination, it surely takes on to us the final touch of nobility.

There are some who think that science is inhuman. They speak or write as if students of modern science would destroy reverence and faith. I do not know how that can be said of the student who stands daily in the presence of what seems to him to be infinite.

Nothing in the progress of science, and more particularly of modern science, is so impressive as the growing appreciation of the immensity of what awaits discovery, and the contrasted feebleness of our ability to put into words even so much as we already dimly apprehend. When we look back we see that the theories of one time are supplanted by those of a succeeding time, and those again yield to something more like the first. But it is no idle series of changes, no vagaries of whimsical fashion; it is growth. The older never becomes invalid, and the new respects the old because that is the case. Surely it is the same with regard to less material affairs. The scien-

tific worker is the last man in the world to throw away hastily an old faith or convention, or to think that discovery must bring contempt on tradition. Scientific research in the laboratory is based on simple relations between cause and effect in the natural world. These have at times been adopted, many of us would say wrongly, as the main principle of a mechanistic theory of the universe. That relation holds in our experimental work; and as long as it does so we avail ourselves of it, necessarily and with right. But just as in the case of research into the properties of radiation we use a corpuscular theory or a wave theory according to the needs of the moment, the two theories being actually incompatible to our minds in their present development, so the use of a mechanistic theory in the laboratory does not imply that it represents all that the human mind can use or grasp on other occasions.

The proper employment of scientific research is so necessary to our welfare that we cannot afford to allow misconceptions to hinder it; and the worst of all are those which would suppose it to contradict the highest aims. Science, as a young friend said to me not long ago, is not setting forth to destroy the soul of the nation, but to keep body and soul together. The student of science should put his whole heart into his work, believing that in some way which he cannot fully comprehend it is all worth while, and that every straining to understand his surroundings is right and good; and, further, that in that way he can learn to be of use to his fellow men.

Steel Mill Electric Driving.

Some notes on the electrical equipment installed by the Metropolitan-Vickers Electrical Co., Ltd., at the Appleby Iron Co.'s Works.

IN a recent issue of the Metropolitan-Vickers *Gazette* an interesting description is given by Mr. W. E. Taylor of the electrical equipment installed by the Metropolitan-Vickers Electrical Co., Ltd., at the steel works of the Appleby Iron Co., Ltd., at Appleby, Lincolnshire. The following notes are taken from the article:—

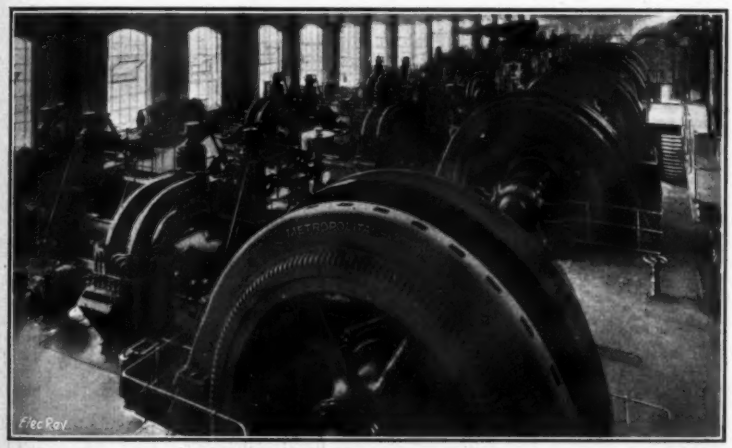


Fig. 1.—Appleby Works Power Station, Engine Room.

Practically the whole of the works is electrically driven, and the power is obtained from a new generating station erected at the old Appleby Works, about a mile distant from the new works. There are six a.c. generators, each driven by a Vickers horizontal gas engine, fig. 1. The rating of each generator is 1,500 kVA, 3-phase, 50 periods, 6,600 volts, 100 r.p.m. The outside diameter of each stator frame is 18 ft. The rotating field, 60 poles, has a diameter of approximately 13 ft., and its weight without the shaft is approximately 41,000 lb. Each generator is excited from a separate motor-driven exciter set consisting of one 67-h.p., 3-phase, 50-period, 440-volt induction motor, driving a 40-kW, 125-volt, shunt-wound d.c. generator. Six such sets are supplied, fig. 3, one acting as a spare. The engines are worked on gas from four blast furnaces, which were already erected at the old works; two new up-to-date blast furnaces were also laid down with electrically-operated chargers. All the gas-engine auxiliaries are electrically driven, and these consist of two 36-h.p. slip-ring induction motors, 428 r.p.m., driving air compressors, and two 60-h.p., 1,475 r.p.m., two 42-h.p., 720 r.p.m., and two 36-h.p., 720 r.p.m., motors driving circulating pumps.

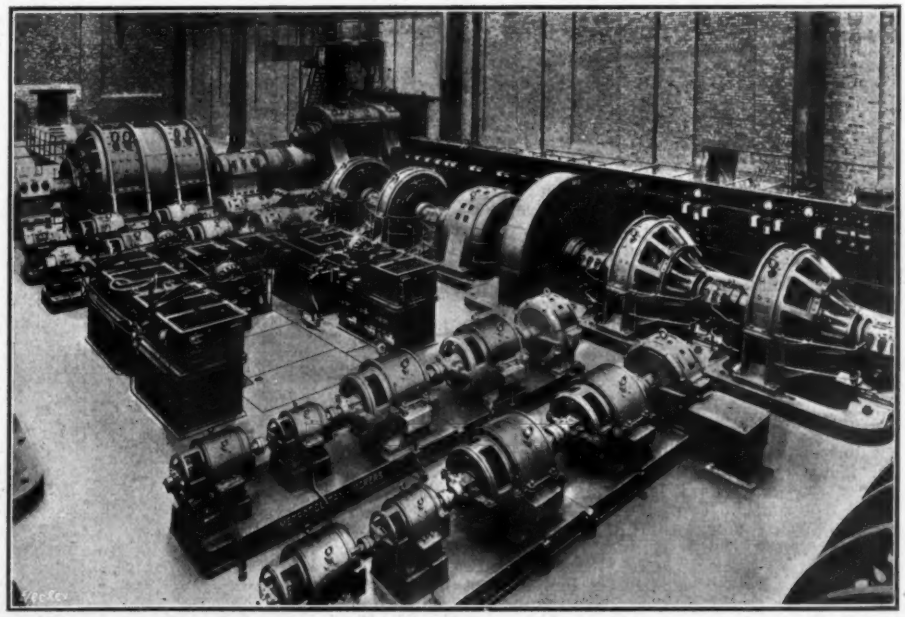


Fig. 2.—Flywheel Motor-Generator and 4- and 5-machine Exciter Sets.

Power is supplied direct to the rolling-mill main equipment at 6,600 V, but is transformed down to 440 V for all the auxiliary plant. There are three rolling mills, a 42-in. slabbing mill, a 40-in. by 10-ft. plate mill, and a 32-in. by 7-ft. plate mill. The slabbing mill consists of one stand of 42-in. diameter rolls, 9 ft. 6 in. long in the barrel, with one stand of gear pinions, 54 in. centres. It is capable of producing plate slabs up to a maximum of 54 in. by 18 in. The driving motor, fig. 4, which is specially designed for heavy-rolling-mill service, has the following characteristics: r.m.s. rating, 6,000 h.p. at 48 r.p.m.; maximum torque, 1,670,000 lb.-ft.; maximum horse-power, 15,300; maximum d.c. voltage, 1,350 volts. It is capable of exerting its maximum torque up to full-field speed of 48 r.p.m., and the heavy torque is therefore available during the first few passes when the heaviest reductions are made. The motor is of the double-armature, forced-ventilated, shunt-wound, commutating-pole type, and is compensated to ensure good commutation on the peak loads.

The 10-ft. plate mill consists of two stands of 40-in. diameter rolls, the roughing stand being 10 ft. wide, and the finishing stand 12 ft. wide in the barrel. The top roll of the roughing stand is driven by 44-in. centres double helical pinions, totally enclosed, the housing for which is situ-

ated in the motor room. The top roll of the finishing stand is driven through a friction drive. The rolling capacity of this mill is approximately 50 tons per hour. A duplicate of the motor driving the slabbing mill is installed for this plate mill.

The 7-ft. plate mill is a 36-in. by 84-in., two-high mill, with a maximum lift of the top roll of 13 in. It is driven by a 5,000-h.p. motor of similar design to that of the slabbing-mill motor, 60 r.p.m., maximum torque 1,166,000 lb.-ft., maximum h.p. 13,300, maximum d.c. voltage 1,350 V.

The three rolling-mill motors are controlled on the Ward-Leonard-Ilgner system. It will be noted that each motor is rated for 1,350 volts maximum, so that in order to obtain full output from each, three 450-volt generators would be required for each mill motor. It was, however, realised that all the mills would not be working at full capacity for some time, so it was decided to install only two generator sets in the first instance, each with four duplicate generators.

The slabbing and 10-ft. mills will be supplied from three generators each, two being on one set and one on the other. This completely utilises one set, and the 7-ft. mill will be supplied from the remaining two generators on the second set. Any one of the generators can be short-circuited in case of breakdown, in which event the slabbing mill will be run only on two generators, the two plate mills thus having the full complement of generators. Each set, fig. 2, comprises four 1,500-kW, 450-volt, 540-r.p.m. d.c. generators; one 3,000-h.p., 3-ph., 50-cycle, 6,600-volt, 590-r.p.m. induction motor; and one cast-steel flywheel, 12 ft. diameter, 38 tons, 176,500 h.p. sec. at 600 r.p.m.

All the generators are both mechanically and electrically identical; each machine is provided with a bearing at one end and a forged half-coupling at the other. The construction of the generators is very similar to that of the mill motors.

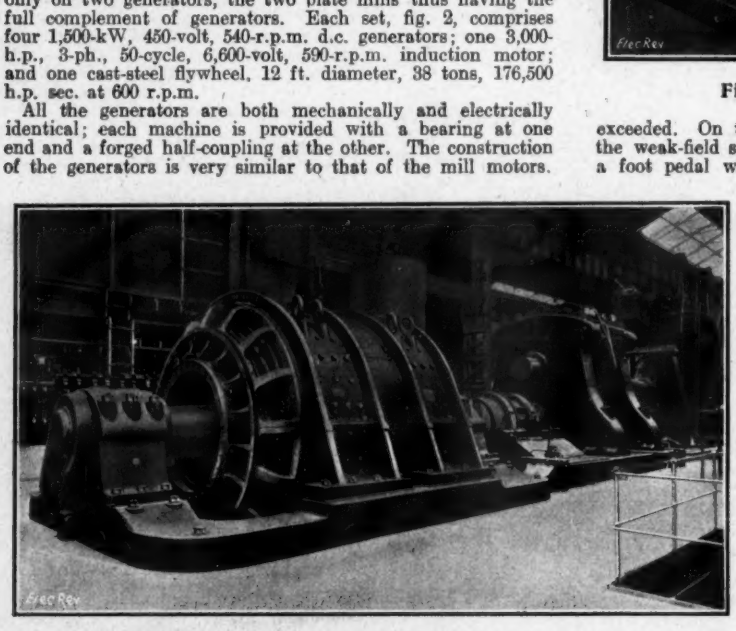


Fig 4.—15,300-h.p. Motor Driving Slabbing Mill.

being shunt wound and of the commutating and compensated type; they are self ventilated.

The driving motor of the set is an ordinary wound-rotor induction motor of the one-bearing type, with a forged half-coupling to bolt up to the flywheel shaft. Provision is also made for sliding the stator completely clear of the rotor, so as to facilitate repair to either the rotor or stator. Each flywheel set comprises five 11-in. bearings for the machines and two 14-in. bearings for the flywheel. All these bearings are arranged for ring oiling, and, in addition, for gravity feed lubrication from a common system for the two sets.

"Exciter control" is adopted in connection with the Ward-Leonard-Ilgner system for the mill motors. With this scheme only the exciting currents of the exciters are handled by the controller, which is thus very much reduced in size and is much easier to operate. Separate exciters are needed for the mill motor and generators, with a constant-potential machine to supply the fields of these machines. Owing to the peculiar characteristic required from the 7-ft. plate mill motor of occasionally working on only two generators, and having a speed variation on weakened field of 40-120 r.p.m., a series stability exciter is adopted, which is operated from a shunt in the main circuit between the generators and the mill motor. This machine supplies a series winding on the main motor, and aids the machine during commutation on the weakened field. To meet these conditions two 4-machine exciter sets are provided for the slabbing and 10-ft. plate mills, fig. 2, rear, and a 5-machine set for the 7-ft. plate mill. A duplicate of the 5-machine set is also provided as a stand-by, fig. 2, front. The driving motor for each set is 160-h.p., 3-phase, 50 cycles, 440 V, 720 r.p.m.; the exciters for the mill motors, generators and exciters are of, respectively, 60-, 50- and 5-kW capacity, and the stabilising exciter is a 25-A, 58-V machine.

In order to meet the demand for quick acceleration in this type of mill, field forcing of the mill motor, generator and exciters is adopted. This consists of impressing a voltage higher than the normal operating voltage on the fields of the machines; a resistance is inserted in the field circuit and is cut out again (by the operation of relays and contactors) when the normal voltage is attained. In the case of the slabbing-mill motor only, forcing on the generator field and its exciter is adopted, as only on very rare occasions is the full-field speed

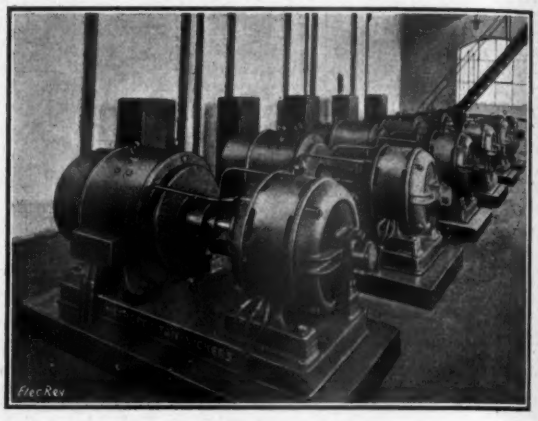


Fig. 3.—Alternator Exciter Sets.

exceeded. On the two plate mills, however, acceleration of the weak-field speeds is accomplished by the driver operating a foot pedal which inserts a resistance in the mill motor exciter armature circuit to force the field current down quickly; the resistance is cut out automatically when the field current reaches the weak-field value.

The circuit-breaker trip circuit may be closed by a trip push button mounted on the d.c. board in the motor-generator house, or the trip circuit may also be closed in the event of any leakage in the Ward-Leonard circuit, if this is sufficient to close the leakage relay switch.

In order that the mill motor shall not creep, due to residual magnetism in the generator field when the Ward-Leonard lever is brought to the "off" position, "suicide" contactors are inserted in the generator exciter field circuit, which put this circuit across the armature of one of the main generators. These contactors are operated by the exciter armature circuit through the Ward-Leonard controller, when the arm is in the "off" position.

In order to cut down the labour required for operating the mills, it was deemed advisable to reduce still further the manual effort required to operate the Ward-Leonard controller, so that the mill operator could also control the operation of the live roller gear, screw downs and manipulators. This was accomplished by coupling the faceplate type controller to a small motor, and controlling it by means of a

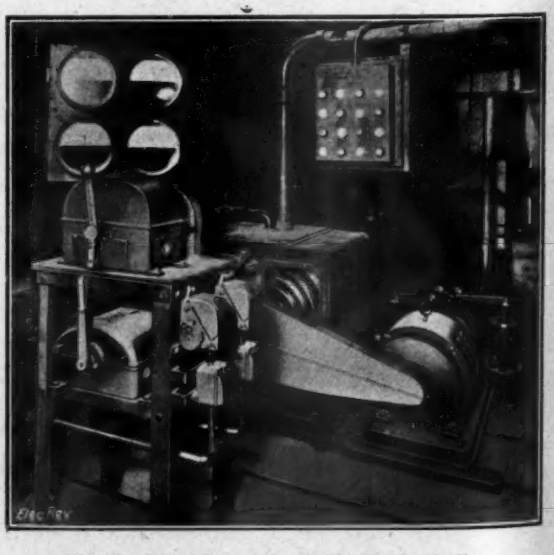


Fig. 5.—Ward-Leonard and Master Controllers.

small reversing master controller that requires very little effort to operate it. Fig. 5 shows the motor-driven Ward-Leonard controller and the master controllers. The armature

of the shunt-wound d.c. operating motor is connected, through a contactor, across the line with a bank of resistances in series, and a second resistance in parallel to ensure a low and fairly constant speed. The motor, which is provided with two shunt fields, one for each direction of rotation, is coupled by chain to the moving contact arm of the Ward-Leonard controller.

The control of each flywheel motor-generator set is accomplished by means of a double-unit automatic slip regulator and starter. Each unit consists of an iron tank containing three fixed and three moving electrodes. The moving electrodes are connected together by a bar, which can be operated by either a handwheel for starting or by a torque motor when in action. A three-pole switch is connected in series with one unit, so that during starting this unit is cut out and the starting peak is thereby reduced.

The stopping of the flywheel motor generator set is effected by means of dynamic braking. This is carried out by supplying the stator windings of the induction motor with direct current taken from the mill motor exciter armature through change-over switches on the dynamic braking panel and on the main h.p. switchboard.

The Machine-Tool Exhibition.

Some of the electrical features of the exhibits at the Fourth Machine-Tool and Engineering Exhibition at Olympia.

ON Wednesday last the fourth Machine Tool and Engineering Exhibition, organised by the Machine Tool Trades Association, Inc., was opened at Olympia by the Rt. Hon. W. C. Bridgeman, First Lord of the Admiralty. The exhibition will continue till September 22nd. From the electrical point of view the show is particularly interesting. The electric drive is predominant, and its advantages generally over other methods of driving are brought home in a convincing manner to the visitor. The total electrical power required for driving the exhibits amounts to 3,000 h.p., and to meet this a new service cable has had to be installed for the premises. The exhibits cover all kinds of machine tools—milling, boring, gear-cutting, wood working, and so on—in addition to printing machines, transport trucks, and many other applications of the electric drive.

It is interesting to note that 14,000 advertising pamphlets have been distributed by the Machine Tool Trades Association, and circulars have been prepared in 14 different languages. In all there are about 180 exhibitors. Only a few directly electrical firms are showing, but the electrical value of the exhibition lies in the driving methods adopted by the non-electrical firms. The principal feature of machine-tool driving nowadays is no doubt the co-operation which exists between the machine-tool manufacturers and the makers of the driving motors. The provisions made for the housing of the motors in the design of all classes of machines have enabled any particular means of power transmission to be adopted, and the belt drive seems to be no longer restricted from this point of view. The following notes deal with exhibits selected to represent generally the electric driving methods in vogue.

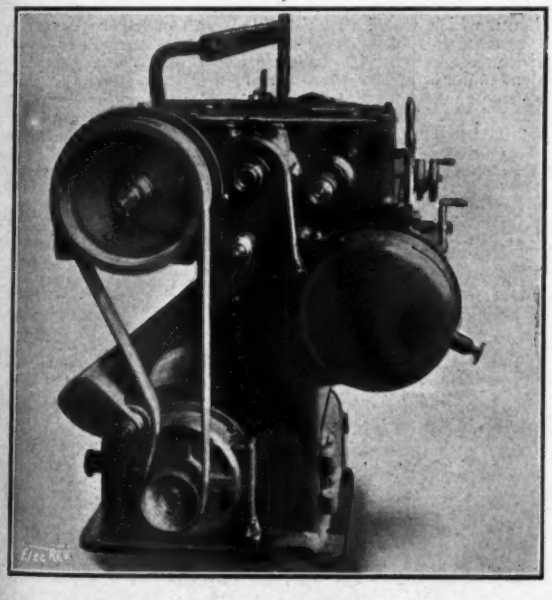


Fig. 1.—6½-in.-centre Lathe; Motor in Cabinet Stool.

On the stand of Messrs. John Lang & Sons, Ltd., is to be seen a 6½-in.-centre sliding, surfacing and screw-cutting lathe, having a 6-ft. gap bed and a twelve-speed all-gear headstock. This lathe is arranged for motor drive by means of a belt, the motor being placed in the cabinet stool under the lathe headstock. Cabinet doors with louvres for the ventilation of the motor are provided. A jockey pulley arrangement is included for giving as great a belt contact on the pulleys as possible, and the whole arrangement is enclosed in a suitable cover. Fig. 1 depicts the driving arrangements for this machine.

A somewhat novel application of motor driving for the heavier class of machine, incorporating the driving arrangements as one unit, is the provision of a countershaft, permitting belt driving, which has decided advantages for such machines over gear driving. Fig. 2 shows an exhibit by the Churchill Machine Tool Co., Ltd. It is a gear-tooth grinding machine embodying some new principles. The correct tooth form is imparted by the production by generation of one large master tooth or cam, which may be a correct involute or as much a departure therefrom as is necessary for quiet running under load. The machine employs a large-diameter grinding wheel covering the full width of tooth at one time, the wheel being mounted on a fixed vertical spindle, adjustable vertically for putting on the cut. No swivelling head is employed. The illustration is, of course, a side view of the machine.

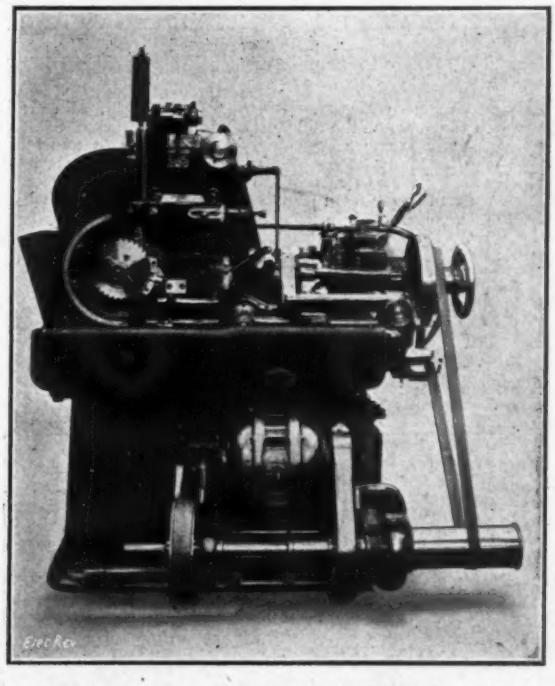


Fig. 2.—Gear-tooth Grinder; Countershaft Driving.

The Butler Machine Tool Co., Ltd., is showing four standard sizes of crank shapers, three of which are in operation and driven by individual electric motors. A new feature of all these machines is the adoption of ball bearings. Gear driving from the motor is adopted in the case of the largest machine, with a friction clutch for stopping, starting and inching. In the smaller sizes an improved ball-bearing jockey-pulley, with belting to a friction pulley on the machine, enables the machine to be started, stopped or inched without arresting the motor speed. The operation of the friction clutch in each case simultaneously applies a brake, so that the ram may be arrested at a given point. An advantage of the jockey-pulley is the facility with which standard machines may be fitted with motor drive. Fig. 3 is a view of an 18-in.-stroke crank shaper, showing the convenient housing for the electric motor and the jockey-pulley driving arrangement. Another interesting exhibit by the Butler Co. is a 12-in.-stroke high-production slotting machine. This is driven by a 15-h.p. constant-speed motor, with a separate small motor for the quick power movements of the table; the two motors are interlocked. The drive

is by reduction gearing, and push-button control is provided. Fig. 4 shows the driving arrangements of this machine. The motor is bedded on a corner of the base plate of the machine at the foot of the trunk.

An interesting example of electric driving for the heavier type of portable machine tool is shown in fig. 5. This is a view of a 9-in. portable universal radial drilling and tapping

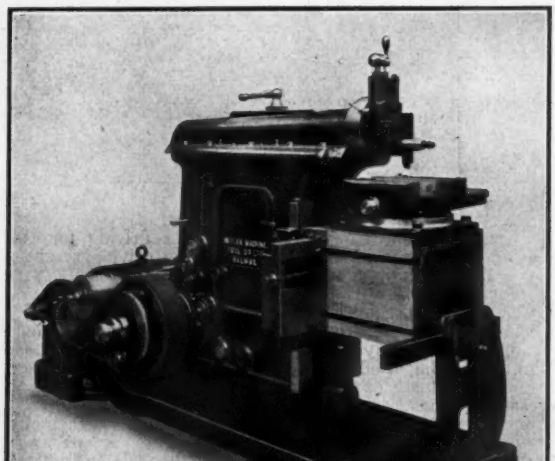


Fig. 3.—18-in.-stroke Crank Shaper ; Jockey-pulley Driving.

machine shown by Messrs. Kendall & Gent (1920), Ltd. It is designed to overcome the difficulties of moving work of a heavy and bulky nature to a stationary machine, and to avoid the necessity in many cases of having to place the work in awkward positions to accomplish the drilling operations. It is constructed in the form of a bogie mounted on wheels which are adjustable, but it can also be supplied for fixing directly to the floor. The drive is by a variable-speed reversible motor carried on the arm, thence by shaft to the gearbox situated behind the saddle, giving six speeds, together with two rates of feed. The spindle is of high-carbon steel, sliding in an adjustable bearing with heavy ball thrust bearings, and is provided with slow and quick hand adjustment, together with the self-acting feeds. It is also made in larger sizes.

An interesting exhibit of Messrs. GEORGE RICHARDS & CO., LTD., is an electrically driven 36-in. duplex turret head vertical

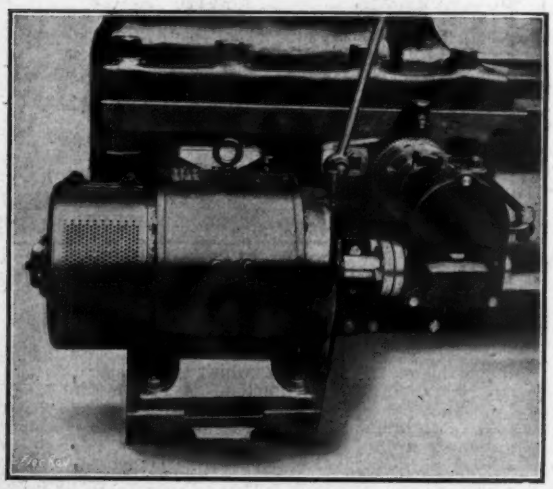


Fig. 4.—Driving Arrangements and Slotting Machine.

boring and turning mill. This has two tables and two heads, and each head and table has independent motion. The tables are driven by separate 7½-h.p. Metro-Vick motors placed at the top of each upright, and the left-hand table is provided with reversing motion. Automatic trips are provided to all motions, enabling the feed to be automatically disengaged at any predetermined point. A centralised oiling system to the main spindle and driving shafts ensures ample lubrication.

A feature of the exhibit by Messrs. WILLIAM ASQUITH (1920), LTD., is an electrically controlled girder radial drilling machine. Machines of this type are of such flexible design that from a stock of standard parts it is possible to assemble immediately a simple machine of one speed and one feed or a machine of three speeds or six speeds with one or three feeds. The combined simultaneous locking of the arm on the column and the slide on the arm is incorporated very easily and simply. The engagement of the feed is automatic when the drill reaches the work. Generally the machine is arranged with the electric cables leading direct to the saddle from a convenient position overhead, but if desired they may be let into the base of the

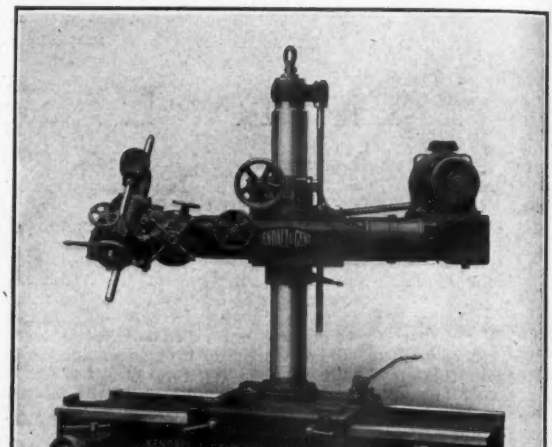


Fig. 5.—Portable Radial, Drilling and Tapping Machine.

column, which would then be fitted with collector gear and the arm would revolve about the column, if necessary, without twisting the cable. A unique feature of this machine is the patent motor supports which permit of any ordinary type and any size of motor being used without having to be specially arranged for. Fig. 6 is an end view of the top portion of a machine fitted with a d.c. variable-speed motor of large dimen-

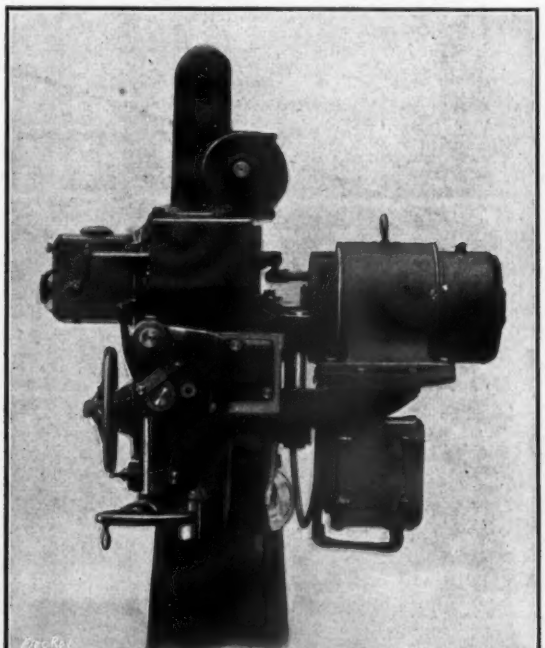


Fig. 6.—Drive for Girder Radial Drilling Machine.

sions. The electrical control gear does not in any way interfere with the operation of the machine.

An interesting range of small portable electric tools is to be seen on the stand of the VIDAL ENGINEERING CO. This includes drills, screwdrivers, nutrunners, grinders and polishers. A 7-in. double-ended ball-bearing electric grinder is on show, and also electric suds pumps (two models); an electric internal grinding spindle for Pearn-Richards boring machines; fractional-horse-power electric motors applicable to light machine tools; and a 3½-in. by 33-in. precision bench lathe and attachments.

(To be continued.)

The 1928-29 Lighting Season.

Reduction in Lamp Prices: Manufacturers' Advertising Schemes.

WITH the approach of autumn and the close of the "daylight-saving" period the thoughts of the public turn to lighting, or are turned thereto by manufacturers of lamps and fittings. Most of the leading makers of electric lamps have drawn up special schemes to bring their wares to the public notice, and all of them possess original and compelling points. They should certainly succeed in bringing about the desired end—the increased sales of lamps.

It is fairly certain, however, that the public will be influenced to a far greater extent by the reductions in the prices of lamps which were announced this week by the Electric Lamp Manufacturers' Association. This should stimulate the sales very considerably. The reductions range from 2d. to 8d. per lamp; generally speaking, they are greater in the high-voltage range (200-260) than in the low-voltage patterns (100-130). The largest decreases are in the opal type. A notable feature of the new price list is that there is now only a penny difference in the charges for vacuum and gasfilled lamps, with one exception.

The following are the companies whose lamps are covered by the new price list:—Metro-Vick Supplies, Ltd. ("Cosmos"), A. C. Cossor, Ltd. ("Cossor"), Cryselco, Ltd. ("Cryselco"), Pope's Electric Lamp Co., Ltd. ("Elasta"), the Foster Engineering Co., Ltd. ("Foster"), the British Thomson-Houston Co., Ltd. ("Mazda"), Neron Lamps, Ltd. ("Neron"), Orion Lamps, Ltd. ("Orion"), the General Electric Co., Ltd. ("Osram"), Philips Lamps, Ltd. ("Argenta"), the Edison Swan Electric Co., Ltd. ("Royal Ediswan"), Siemens Electric Lamps & Supplies, Ltd. ("Siemens"), the Stearn Electric Lamp Co., Ltd. ("Stearn"), the Stella Lamp Co., Ltd. ("Stella"), Tungsram Electric Lamp Works (Great Britain), Ltd. ("Tungsram"), and "Z" Electric Lamps & Supplies, Ltd. ("Z").

Fig. 1.—The "Siemens" Design.

Fig. 2.—The "Mazda" Dancing Girl.

We give below some notes on the methods which are being adopted by some of the leading lamp makers to popularise their products during the coming autumn and winter.

SIEMENS ELECTRIC LAMPS & SUPPLIES, LTD., is utilising the hoardings as the principal means of bringing its lamps before the public notice. In London and all the chief provincial towns sixteen- and eight-sheet posters will be exhibited bearing the design reproduced in fig. 1. This is a rosy-cheeked, blue-eyed boy astride a Siemens "Silvalux" gasfilled lamp, holding aloft one of the company's clear-glass lamps. The colour scheme is orange on a deep blue ground. The same design is being used for showcards and other advertising media, including double-crown posters at Underground railway stations and framed advertisements in the lifts. Another, simpler, design of a very effective nature has been produced for the clear-glass gasfilled lamp. This will be displayed on railway and carrying companies' vans in London during the lighting season. The leading London daily papers are to be used extensively for the company's announcements, and series advertisements will be inserted in the high-class monthly magazines. Advertisements will also appear in the principal trade papers.

For the retailer of "Siemens" lamps a special window centre-piece has been prepared. This employs the "Our Sunbeam" design wired for flex, lampholder and adaptor to enable a "Silvalux" lamp to be used at night in the boy's hand. The display is 3 ft. 6 in. high and 2 ft. 6 in. wide.

The outstanding feature of the lighting propaganda of the GENERAL ELECTRIC CO., LTD., is the simplified "Pearl Osram" line. This consists of five sizes—15, 25, 40, 60 and 100-W—which replace no fewer than 65 types of "Osram" lamps. It is superfluous to stress the advantage of this to the dealer in the way of reduced stocks, and consequently more available space and less tied-up capital. The G.E.C. is to undertake an intensive advertising campaign which embraces all the most representative trade and lay papers and periodicals throughout the country, and this will be reinforced by original and striking aids for the retailer in the form of showcards, window displays and folders.

Fig. 2 is a reproduction of a beautiful design which is being employed by the BRITISH THOMSON-HOUSTON CO., LTD., in its season's propaganda. This picture, "Beauty Enriched by Light," is the work of a well-known artist, and is brightly executed in striking colours. The design is used for a showcard 22 in. high and 16 in. wide, provided with a strut and hanger. The leading feature of the campaign, however, is an illuminated window display possessing great attraction. It consists of three panels forming a folding screen, which, when fully extended, is 47 in. wide, 40 in. high, and 5 in. deep. The centre panel shows the "Mazda" girl, with a child in her arms, switching on a table lamp, to the child's evident delight. A soft light emanates from the table lamp, in which there is a "Pearl Mazda" lamp fixed in a compartment at the back of the display and controlled by a thermal flasher. A second lamp, fitted in another compartment behind the display, provides illumination for lettering on the lower part of the centre panel. The display is equipped with a thermal flasher, two lampholders and an adaptor on a length of flex; the dealer has only to supply the two lamps. In addition to these, the company has brought out a most attractive catalogue, a number of leaflets arranged for overprinting with the dealer's name and address, and a special folder for the trade dealing with the means of obtaining supplies of advertising material and giving a number of hints concerning the selling of lamps.

THE EDISON SWAN ELECTRIC CO., LTD., has produced a special window bill for retailers drawing attention to the reductions in the prices of "Royal Ediswan" lamps, as well as a new catalogue and folders. The company is undertaking an

intensive Press advertising campaign during the winter months, and a folder has been issued showing some of the national newspapers in which the advertisements will appear. The Ediswan nurse with the slogan "Nurse Your Sight" will again be prominent in the company's publicity. For window display purposes a number of cardboard cut-outs are available, and the before-mentioned folder contains an illustration of a specimen window display, as well as reproductions of show-cards, &c.

METRO-VICK SUPPLIES, LTD., has also produced an artistic window bill announcing reduced prices for "Cosmos" lamps. It is in three colours, and takes the form of a news placard. This company has also published an attractive new catalogue with the new prices.

Correspondence.

***Correspondents should forward their communications as early as possible.** No letter can be published unless we have the writer's name and address in our possession.*

Radio Valve-anode Capacitive Resistance.

I wish to thank Mr. Ernest W. Braendle and Mr. A. H. Johnson for their replies to my letter of the 11th inst. Mr. Braendle and myself appear to be somewhat at cross purposes, judging by the second and the last paragraphs of his letter.

In my effort to make my letter short enough for the Editor to be likely to publish it, I fear that I did not make myself quite clear enough to these gentlemen in my analysis of all the rather complex factors involved. I did not, naturally, for one moment, intend to indicate that under no-load, or "static" conditions, which were not considered in the article in question, there is an actual addition of + or $-\mu V_g$ to the h.p. voltage, but that the mechanism of the valve gives this effect as regards the output circuit on load.

Neither Mr. Braendle's nor Mr. Johnson's account of the matter seems to me to be at all clear on the valve's behaviour from the viewpoint of the anode voltage and signal current. I must therefore endeavour to show the exact and definite conditions upon which my arguments are built up before proceeding further, the same symbols being used as before.

Consider fig. 1, below. Here we have the i_{dc} and E graph for an ordinary non-inductive resistance R. The quantity we term the "resistance" is defined as the slope of the locus C O_1 and is denoted by

$$R = E/i_{dc} \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

As C O_1 is a straight line, its slope is constant at all points, and equals

$$CB/BA = BB'/AA' = E/i_{dc}$$

for A'A is the variation in i_{dc} of di which causes a variation in E of dE, which is B'B.

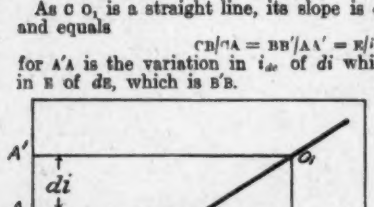


Fig. 1.

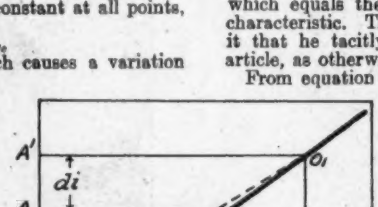


Fig. 2.

If dE is from a generator of a.c. in series with a battery giving a voltage of E volts, the resistance to both voltages is the same, whatever their values. So often does this state of affairs hold that we may, perhaps, be tricked by those, at times, treacherous servants, memory and habit, into thinking that R is a concrete and constant quantity in any one piece of apparatus, instead of a mere ratio between the voltage and current, which may vary, for instance, with the magnitude of the former. This is the case with a valve (see fig. 2) where the amplified signal current di "meets" a "slope resistance."

$$R_p = dv/di = B'B/AA'$$

on the graph, where dE is the voltage set up across R_p; and yet the ratio

$$E/i_{dc} = R_1$$

varies with E at whatever point it is on the curve (the latter is what is often termed the valve d.c. resistance.)

This effect is due to the bend at the bottom of the curve, below the working portion outside which di is not allowed to stray. For instance, in fig. 2 OB/OA does not equal O_1B'/O_1A', as may be seen by the dotted loci to O and O_1 from C, the slopes of which are measured by these fractions.

Obviously, as long as E is on the straight portion of the valve curve, and dE does not over-run it, di will "meet" a constant slope resistance R_p. Under these conditions di will produce a voltage across the valve of

$$di\,R_p = V_g \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

not equalling $di\,R_1$; whereas the total anode current i_a will produce a voltage across the valve equalling

$$i_a R_1 = E \quad \ldots \quad \ldots \quad \ldots \quad (2.1)$$

Conclusion 1.—*We thus have the valve behaving as a constant-slope resistance R_p to the signal currents in its plate circuit, and a varying resistance R_1 to the steady anode current, which variations are controlled by the grid voltage and produce the signal currents.*

Now, from this, as is obvious, we have

$$i_{dc} \mp di = E/(R_1 \mp dR) \quad \ldots \quad \ldots \quad (3)$$

where dR is the variation in R_1 caused by V_g. From elementary theory

$$E/(R_1 - dR) = (E + dE)/R_1 = i_{dc} + di \quad \ldots \quad (3.1)$$

That is to say that, in any circuit, precisely the same effect is found by varying R_1 with E constant as by varying E with R_1 constant, where dE and dR are of opposite signs.

Conclusion 2.—*A valve's amplified signal current may be considered as set up by a voltage in series with the h.t. battery, the d.c. resistance remaining constant.*

This assumption is far more convenient for the analysis of valve output circuits than the other, and is just as accurate. Thus

$$i_{dc} = E/(R_1 + r) \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

where r is the resistance of the load to d.c., and

$$di = dE/(R_p + Z) \quad \ldots \quad \ldots \quad (5)$$

where Z is the a.c. impedance of the load.

The total anode current is

$$E/(R_1 + r) \mp dv/(R_p + Z) = i_{dc} \mp di \quad \ldots \quad (6)$$

But what relation has dE to V_g? The answer is that dE is obviously the amount by which E must be varied to vary i_{dc} by di, *i.e.*, it is identical with dE in the fundamental valve equation

$$\mu = (\partial i/\partial V_g)/(di/dE) \quad \ldots \quad \ldots \quad (i)$$

from which, by simple algebra,

$$\mu\, V_g = dE \quad \ldots \quad \ldots \quad \ldots \quad (7.1)$$

If V_g is a sine wave we have, for the instantaneous value of the plate current

$$E/(R_1 + r) \mp V_g \max \sin 2\pi f/(Z + R_p) = i_a \mp di \quad (8)$$

which is identical with the final equation in my letter of the 11th, except that this neglected the load d.c. resistance r.

These results apply to Mr. Braendle's and Mr. Johnson's arguments as follows:—

First, from "Conclusion 1," we cannot represent the valve circuit by a battery in series with the varying d.c. resistance, as Mr. Johnson suggests, for then the slope resistance to di is missing. Also, we cannot represent it by a battery in series with the slope resistance, as Mr. Braendle suggests, for R_p does not vary, as may be seen by plotting a family of E/i_a curves for various working grid voltages and noting that they are all parallel. Thus, the only case where a valve could be represented by a pure variable resistance in this manner is if we take the purely hypothetical case of a valve, the R_1 of which equals the R_p, *i.e.*, there is no bottom bend in the characteristic. Though Mr. Braendle does not say so, I take it that he tacitly intends to make this reservation in his article, as otherwise it is incorrect.

From equation (8) (and also the fundamental ones (3) and (3.1), briefly summarised in "Conclusion 2"), where the grid voltage is alternating the valve carries a.c. superimposed on the d.c. in the plate circuit. Thus there is no foundation for Mr. Braendle's distinction between this and fluctuating direct current, and his argument falls to the ground.

Mr. Johnson is answered also by the foregoing almost entirely, but I would like to point out that by the internal resistance and voltages of the equivalent generator circuit he mentions are meant the *working* R_p and μV_g of the valve under consideration. Hence the h.t. is taken into account. Also, the Pentode is not "matched" to a 2,000-ohm load in the sense of the word used in generator practice (see Dr. N. W. McLachlan in the *Wireless World* for July 11th last).

J. H. Owen Harries.

Frinton-on-Sea, *August 26th*, 1928.

I should like to make a few remarks regarding the points mentioned by your correspondent in last week's issue, who signed himself "B.Sc., A.M.I.E.E."

Regarding (1), the writer states that the circuit shown by fig. 1 of Mr. Harries's letter is the equivalent of the valve when acting as an amplifier, and can be proved mathematically. I must say that I have never seen this demonstrated by mathematics, but always arrived at by some doubtful logical method.

(2) The writer states that the slope resistance and not the d.c. resistance enters into calculations with valves. This would be so if it was simply the anode potential which was varying (note that it is from this argument that the slope resistance is derived), but what he appears to have overlooked is the fact that *before the anode potential can vary, the plate current must vary*, which, in its turn, is due to *the variation of the d.c. resistance* of the valve, caused by the input grid variation.

(3) It is fairly clear that the d.c. resistance of the valve must not vary sinusoidally to give a sinusoidal plate current, for the plate current is proportional to the reciprocal of the valve resistance. The writer makes the statement that

periodic variation in d.c. resistance would in general cause rectification, but with correct matching the amount of rectification is negligible.

It is interesting to note that in the circuit shown in fig. 1, where the resistance consists of a constant amount, plus a

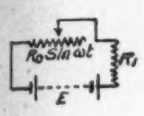


Fig. 1.

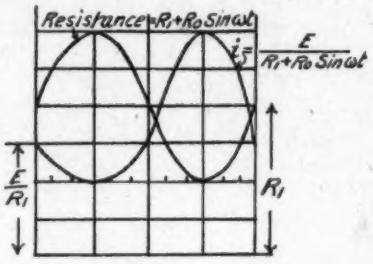


Fig. 2.

perfect sinusoidal amount, rectification does actually take place: for the current $i = E/R_1 + R_0 \sin \omega t$), which when plotted gives a wave very similar to that shown in fig. 2.

A. H. Johnson.

London, *August 31st*, 1928.

Electric Heat in the Garden.

In your current issue your correspondent, Mr. F. J. Moffett, deprecates the proposals of Mr. R. Borlase Matthews to apply electric heat to the ground for the stimulation of plant growth, and points cut the obviously higher heat value to be obtained by the direct combustion of fuel with heat transmission to the ground by hot-water circulation. Such a scheme is barred out, however, by its cumbersome nature, by the heavy expense of hot-water transmission over large ground areas, and by the short life of hot-water pipes when buried in damp earth.

The application of heat units in the cooling water from steam generating stations as suggested, to warm the soil, is a subject worth attention, but such a method is necessarily far too circumscribed to have any substantial beneficial effect on the horticultural industry.

Your correspondent points out that the electrical method of soil heating is justified in Norway and Sweden, as the energy is derived from water-power plant, but he entirely overlooks the fact that in this country there are hundreds of thousands of horse-power of electrical machinery in our generating stations which has to be kept in operation continuously, but which is carrying little, if any, load for 18 to 20 hours a day, simply because there is little demand for electricity during those hours; nevertheless, the declared electrical pressure has to be continuously maintained at the consumers' terminals.

Under these conditions any extra Board of Trade units can be generated on such lightly loaded plant (if of the best modern type) by the expenditure of 8.5 lb. of steam per unit generated. A modern boiler plant, which is already at work supplying the small amount of steam required for these light loads or is carrying banked fires, will easily supply this extra 8.5 lb. of steam from one pound of coal. If the coal costs 16s. 8d. per ton delivered—a generous average price—it follows that each extra Board of Trade unit is produced for one-tenth of a penny.

Allow an average 30 per cent. loss in transformation and distribution, and the bed rock cost per Board of Trade unit delivered to the soil is 0.143d. per unit.

The horticulturist could afford to pay 0.25d. per unit, or even 0.3d. for this service, and the hours during which the energy is delivered to him, the rate of delivery, and the pressure at which the energy is supplied, are matters of indifference to him, but of vital importance to the electricity supply undertaking.

The means of differentiation between the constant-pressure supply sold for ordinary purposes and that used for horticultural purposes, is to employ the "change-circuit" system of distribution for the latter. This system of supplementary electricity supply has already been demonstrated before many well-known electrical engineers in the English Electric Co.'s works at Stafford, and is to remain available for demonstration purposes until one or two permanent plants are at work on commercial lines.

On the lines indicated, the application of electricity to horticultural purposes forms one of the best channels of development open to the electricity supply industry. It can be supplied on a tariff which expert gardeners can afford to pay. Outlets of this character abound quite close to many of the generating stations of the country, and, last but not least, the supply to the garden can be given at such times and in such volume as will keep the generating plant continually at work under its best and most efficient operating conditions.

In the writer's opinion, Mr. Matthews is quite justified in his claims, at any rate so far as the electricity supply side is concerned, and he is to be congratulated upon his enterprise and accurate prevision.

Ubique.

August 31st, 1928.

Mr. R. Borlase Matthews, in your issue of August 10th, gives valuable data for the energy required for the heating of soil, as well as some results from the heating of forcing beds, &c. As Mr. F. J. Moffett kindly recalls, I have for years suggested that the warm circulating water from power stations could be used for plant-forcing purposes, a suggestion once voiced during the discussion of one of Mr. Borlase Matthews's I.E.E. papers and noticed by him in his reply to the discussion. It is clear that the energy so supplied is far cheaper than the equivalent electrical energy from the same station. It is now a waste which it costs money to dispose of. I am grateful for the data because they give a basis for calculating the area which could be served from a station of given output.

I further suggested that this utilisation of 70 per cent. of the heat value of the coal burned might very well enlarge the choice of economical sites for power stations.

Another suggestion, perhaps a little closer to Mr. Borlase Matthews's heart, was that the market gardener, farmer, &c., might well supply himself and his neighbours with electrical energy as a by-product of the fuel used in his frames, glasshouses, &c., by using either condensing water from steam plant, or cooling water from internal-combustion plant, for his culture. Perhaps this might help to solve the problem of rural supply.

An expansion of this idea, fantastic perhaps now, is that this country may some day find it worth while to use a part of its coal production to increase the native supply of food, getting also electrical energy as a by-product of forced cultivation, if it should appear that more food can be so obtained than by the present indirect process of exporting coal and commodities produced by the use of coal to pay for imported foodstuffs.

Henry M. Sayers.

London, *September 1st*, 1928.

Engineering Mathematics.

In your issue of August 17th "Engineering Lecturer" duly and truly points out the need for calculus teaching by engineers, but he advocates the teaching of algebra by specialists. It was, I think, Prof. John Perry who advocated the teaching of mathematics by a physicist and of physics by an engineer. My own experience as teacher in a technical college fully bears out Perry's advice.

Yet "E.L." should be thanked for bringing up this matter and also for his advocacy of the teaching of mathematical history, as the best method of raising interest in mathematics—especially algebra.

Coming to the details of algebraic teaching, it would be well if it began with equations and if the four rules were left to arithmetic.

Edward C. Barton.

London, *August 24th*, 1928.

High-frequency Currents and Diathermy.

In your interesting article on "High-frequency Generation" it is strange that your contributor fails apparently to place the physiological phenomena noted as merely the effects of heavy diathermic auto-condensation.

Diathermy (*lit.* "heat through") or electrothermy constitutes a very important branch of electromedical knowledge, and deserves to be better known.

Although excessive currents no doubt will bring on headache, conversely suitable currents applied across the temples will very often cure headache due to nervous disorders.

From hand to hand, 0.8 ampere is the usual current that can be borne by the average man for a minute or so, although some very sturdy subjects can carry as much as 1.2 amperes, the limiting factor being the aching set up in the wrists due to the heat therein generated at the narrowest part of the circuit and thus of highest resistance. In thicker parts of the body currents of 3 amperes or more can be tolerated if suitably distributed.

With quite small apparatus using only 1 or 2 kW, all the phenomena described by your correspondent may be produced. The effects are purely thermal (C^2R), the current taking its course between points in a straight line or in the nearest possible way. Thus, two electrodes placed in albumen will cook a path directly between them, whereas parts adjacent remain raw. Similarly with a potato or piece of meat.

The temperature of a patient can be raised to 102 deg. F. in about 20 minutes by the suitable application of current of the order of 1.5 amperes, and the writer is satisfied that this is one of the most perfect cures for insomnia.

Finally, electrothermy is used in bloodless surgery, in which the knife (one electrode) is used to remove growths, &c., the electrode searing up or "cooking" the ends of the blood vessels in the tissue and thus avoiding hæmorrhage. Those interested should see Nagelschmidt, Cumberbatch, &c.

Diathermic apparatus under medical control should be installed wherever u.v. or sunlight apparatus is used, and small sets might usefully be used in the home.

Apparatus of this nature merits the attention of the ordinary electrical engineer, as, besides being potentially profitable, it can, under capable hands, effect an immense amount of good.

A. Mortimer Codd.

Esher, *August 27th*, 1928.

Forecasting Raw-Material Prices.

The contribution in your issue of August 17th entitled "Forecasting Raw-Material Prices," whilst interesting as indicating the necessity for some method of forecasting price fluctuations, is nevertheless disappointing from a practical point of view.

It is by no means clear to the writer that such a "science" has already arrived, and even so it would scarcely appear to do more than indicate the probable trend of prices a few years hence. Such indication may be of interest to certain world producers of staple commodities, but it possesses no practical value for the thousands of firms in which rapid turnover and quick decision are features of business transactions.

We are told in the article mentioned that the price charged by the monopolist is not necessarily the highest that can be got, but one determined by certain other influences, as, for example, the possibility of the consumer adopting substitutes. This is very true, but how does this knowledge help a purchasing department to forecast what the price of a "ring-controlled" article will be in three months' time? Certain classes of cables were reduced in price by 5s. this year, whilst I have this morning been notified of a reduction in price of electric lamps to take effect to-day. These and similar price variations are determined by the interested parties in secret conclave with all the facts before them, which are not available to the ordinary buyer.

Unless prime producers and manufacturers are prepared to place all their cards on the table to enable the buyer to use his own judgment, price-forecasting will have a very circumscribed future. The *précis* of elementary economic doctrine offered us by your contributor does not go far towards a solution of the practical difficulties outlined above, and until a treatment on practical lines is developed, one may take leave to be somewhat sceptical of this newly-found "science."

It would be interesting to hear your readers' views on this subject.

E. Doble.

London, *September 1st*, 1928.

Does it Pay to Acquire Knowledge?

May I again trespass on your valuable space, as I feel that Mr. P. Shearer's letter calls for a little explanation? To start with, I am not so fortunate as to earn my living by working in an office. I am on "shift work" in a traction sub-station, and I normally (without overtime) work 58 hours per week (whilst on night duty); if this figure is subtracted from 90 there is a balance of 32 hours left for studying, which is not much in excess of the time suggested by your correspondent, *i.e.*, 25 hours per week. It may appear extraordinary, but nevertheless it is no exaggeration when I say that I have often worked longer than 100 hours per week, for short periods before examinations. I admit that such hours are most trying.

Your readers who have railway experience will know that the rates of pay in such undertakings are lower than those prevailing in ordinary commercial firms, the reasons being the additional security afforded, and the advantages of free travelling, &c. It may also interest Mr. Shearer to know that within the past few days my superiors have recommended me for promotion. If my directors confirm this recommendation my income will then exceed £263 per annum. This will make my fourth promotion in a little over three years' total service.

Mr. Shearer very kindly advises me to get out of my present job, but he has not told me how to get another one. I have answered several hundred advertisements in the Electrical Review, but I have received less than half-a-dozen replies, and none of these were of any use to me. I have also tried advertising in the "Situations Wanted" column of your journal, and I received two replies to one insertion, neither of which was, however, of any use to me.

I was very interested in the reply of "Aged 36," and I agree that there is a lot of truth in his letter. Although I am on the verge of receiving my fourth promotion in a little over three years, I have had a gigantic struggle to obtain it. My own experience has led me to conclude that it is not the clever man that gets on. It is the man who possesses that magic wand "influence."

Ambitious.

August 28th, 1928.

I have served a proper apprenticeship in the electrical industry, had two years' technical education in an electrical engineering college, and have also taken a correspondence course of electrical engineering. I have had four years' municipal experience, and although I am carrying out the duties of an electrical engineer, the surveyor to my Council is my superior and I am classed as a foreman.

For this reason alone I have lost a number of good positions during the past few years. The position I am placed in is intolerable, yet, being a married man, I have no alternative but to carry on.

My department, for this reason, is inefficient, and my staff are using foreign materials which are extremely shoddy, the ordering of which I have no control over. We have a fairly large undertaking, and from my practical experience undoubtedly in a few years' time we shall have a considerable amount of maintenance to do. My brains and initiative are for the time being dead, and we are like a derelict ship driven by the storm, God knows where. I can assure your readers that this condition of affairs would be a comedy if it were not such a tragedy. We have Board of Trade Regulations, Factory Regulations, Electricity Commissioners, &c., yet men with no electrical knowledge can control an electrical department.

We talk about the shoddy wireman, but the person in charge with no experience is certainly a greater danger.

I have received instructions to connect up installations which I would have condemned, such as heating circuits straight from a 5-amp. d.p. switch without switches controlling the plugs.

In conclusion, I think it time that persons without experience should not have control over an electrical department. Also, I would like the opinion of some of your readers who may be placed in the same category as myself.

I am fed-up—but still trying to be an optimist.

Graduate I.E.E.

August 27th, 1928.

The experience of a "Young Installation and Maintenance Electrician" aptly illustrates the outlook of some superintendents.

A keen young man before the 1914 "bust-up" sat for and passed the City and Guilds of London Final Wiremen's Exam.; on passing to his "super." the question paper with the report on the exam., he was disappointed by being offered one farthing per hour increase in his pay.

Ambitious but Disgusted.

August 28th, 1928.

British-built Electric Ships.

My attention has just been called to the very interesting leading article which appeared in your issue of June 29th, on the question of British-built electric ships, which should be read by all progressive electrical power engineers in the country. There is no question so significant to the welfare of this country, as the development of this tremendous "old" yet "new" English industry. Your statement that the shipowners in this country have not taken kindly to the idea of electric ships in my opinion (based on my 20 years' experience amongst them) is not quite correct, as in nearly every case (and I have had many hundreds of very interesting cases) the English shipowner has always looked on the great economy of the electric ship with more than passing interest; it is not the business-like English shipowner who is to blame for the fact that during the last two decades practically nothing has been done in this country, the birth-place of electric ships.

It is small wonder, however, that this state of affairs has been brought about, when some of the best-known members of the electrical trades have so thoroughly condemned this means of building up England's great shipping industry, in public statements in the past regarding the so-called dangers of the equipment of such excellent and economical vessels. It is now over 18 years since I read my paper at the Institution of Naval Architects on electric ships, and the statements of certain electrical engineers, in fact, Faraday gold-medallists, frightened off the shipowner who had placed the contract for the world's first electric ship, the *Ivy*, of Liverpool; the effect was that the marine insurance companies indicated that their insurance fees would rise, and what reasonable shipowner could be expected to put in propulsion plant (however efficient) if his insurance rate was to be increased, based on statements which were given by so-called leaders in the electrical engineering industry at the time?

The contract for this ship was placed on October 28th, 1909, by Mr. Arthur Magginis, M.I.Mar.E., of Liverpool, whose practical sea-going experience was second to none in this country, he being a retired White Star Line superintending engineer.

The real reason why the American shipowner comes to this country for his ships (it is not bound entirely to electric ships) is because, thanks to free trade in steel, the shipbuilder can use much cheaper steel than is possible in the United States; at the same time he is well aware that our shipbuilders are highly experienced in the details of real ocean-going ship construction. It must also be remembered that the American workman gets a great deal more money than do our industrial workers, which tends to reduce the price of the British vessel, and it must not be forgotten that an English-built ship fetches a higher secondhand price than any other type of boat.

I have made arrangements for the building of my "Paragon" electrical ship propulsion machinery in many countries, but I find that the English prices are still a long way above those of other countries under the same specification; I think that is partly due to the fact that, owing to the very small demand for high-power squirrel-cage induction motors in this country, it of course means a special set of calculations and patterns for these high-power ship propellers.

However, be that as it may, I am indeed very pleased to read the very interesting article in the Electrical Review, as I hope to see that before long the demand for real electrical ship propulsion has become more than a passing dream, as many of my past critics have previously remarked.

Now that the patents which were granted in 19 countries at a cost of over £1,300, owing to lapse of time, are public property, there is no reason against the straightforward installation of the simplest machine in the world, namely, the squirrel-cage induction motor, for the purposes for which it was claimed in connection with ocean-going ships.

William P. Durtnall,
Captain.

London, *August 29th*, 1928.

[This letter has been shortened.—Eds. Elec. Rev.]

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1927.

2,000. "Electrical control of synchronous movements." W. Gaye. November 24th, 1927. (295,144.)
2,570. "Electrical apparatus for preventing and removing deposits in water-evaporating vessels." L. Erenyi. February 2nd, 1927. (Convention date not granted.) (265,080.)
3,206. "Electro-mechanically-controlled telephone and remote switching systems, and switching apparatus therefor." F. Aldendorff. February 4th 1927. (Cognate applications 11,745/27 and 16,199/27.) (295,214.)
3,787. "Means of reducing distortion in telephone circuits." C. Robinson and A. J. Aldridge. February 10th, 1927. (295,337.)
4,230. "Alternating-current relays." L. H. Peter and Westinghouse Brake and Saxby Signal Co., Ltd. February 15th, 1927. (Addition to 244,234.) (295,618.)
4,767. "Projection of light." L. J. Steele and H. Martin. February 19th, 1927. (295,733.)
5,877. "Gasfilled electric discharge tubes." H. Wade (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). March 2nd, 1927. (295,203.)
6,743. "Line-finder arrangements for automatic telephone exchanges and other remote-control systems." H. Baron (legal representative of F. Aldendorff (deceased)). March 10th, 1927. (295,409.)
8,966. "Time mechanism for use in conjunction with gas controllers, electric time switches, and other timing devices." Horstmann Gear Co., Ltd., and A. Horstmann. April 1st, 1927. (295,296.)
9,200. "Electric primary cells." J. S. Crossley. April 4th, 1927. (295,219.)
9,201. "Electric secondary cells." J. S. Crossley. April 4th, 1927. (295,220.)
9,337. "Signal apparatus associated with electrically-controlled machinery." A. E. Billingsley. April 5th, 1927. (295,223.)
9,489. "Television and similar apparatus." Dr. A. H. Brunn. April 7th, 1926. (269,182.)
9,676. "Mounting or suspension of resistances in electric furnaces." H. Wiggin & Co., Ltd., and A. G. Lobley. April 8th, 1927. (295,299.)
10,078. "Suspension and shielding of radio valves." A. Hall and Ferranti, Ltd. April 12th, 1927. (295,414.)
10,174. "Manufacture of lead-sheathed cable and apparatus therefor." Siemens Bros. & Co., Ltd., and E. R. Hubbard. April 13th, 1927. (295,416.)
11,937. "Voltage control in parallel alternating-current circuits." English Electric Co., Ltd., and W. E. M. Ayres. May 4th, 1927. (295,231.)
11,961. "Tone-tube for sound-reproducing machines." A. J. J. Van Akkeren. July 15th, 1926. (274,424.)
11,988. "Telephonic apparatus." P. K. Turner and W. J. Rickets. May 4th, 1927. (295,342.)
11,992. "Repeatered transmission lines for telephone systems." Standard Telephones & Cables, Ltd. (Western Electric Co., Inc.). May 4th, 1927. (Addition to 264,593.) (295,236.)
12,041. "Alarm devices for automatic telephone systems." W. J. Randall. May 5th, 1927. (295,242.)
12,073. "Apparatus for the electro-magnetic separation of ores." A. Davies. May 5th, 1927. (Cognate application, 29,713/27.) (295,417.)
12,084. "Transforming electric currents." British Thomson-Houston Co., Ltd., and J. C. Read. May 5th, 1927. (295,243.)
12,087. "Electric fuses of the cartridge type." English Electric Co., Ltd., and A. M. Pooley. May 5th, 1927. (295,244.)
12,193. "Thermionic valves or electron discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. February 21st, 1927. (285,799.)
12,219. "Impulse emitters for subscribers' stations of automatic telephone exchanges." C. Barth and A. Domaschko. May 6th, 1926. (270,745.)
12,224. "High-tension electric discharge vessels." Siemens-Schuckertwerke Ges. (in liquidation). May 8th, 1926. (270,746.)
12,261. "Thermionic valves or electron discharge tubes." S. R. Mullard (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). May 7th, 1927. (295,343.)
12,285. "Electric protective systems." A. Reyrolle & Co., Ltd., R. W. Biles, and J. Mirrey. May 7th, 1927. (295,251.)
12,312. "Electric generating systems." D. E. Batty and Associated Equipment Co., Ltd. May 7th 1927. (295,252.)
12,481. "Illuminated signals." A. V. Tomlinson (Union Switch & Signal Co.). May 10th, 1927. (295,347.)
12,510. "Apparatus for simultaneously recording motion and sound." A. Quintiliani and L. Pineschi. December 15th, 1926. (Addition to 269,486.) (282,334.)
12,566. "Portable electrically-driven machine for planing, grinding, polishing, drilling, milling, sawing, and other cutting operations." B. Simonides. May 10th, 1927. (295,348.)
12,572. "Telephone systems." Standard Telephones & Cables, Ltd., E. P. G. Baker, and A. H. Cameron. May 10th, 1927. (295,421.)
12,617. "Magnetically-actuated friction clutches." M. Walker. May 11th, 1927. (295,423.)
12,658. "Electric switches and the like and driving arrangements therefor for automatic telephone and other remote-control systems." F. Aldendorff. May 11th, 1927. (295,426.)
12,668. "Telephone systems." Automatic Telephone Manufacturing Co. Ltd., and L. M. Simpson. May 11th, 1927. (295,428.)
12,691. "Multiple thermionic valve amplifiers." Dr. S. Loewe. May 12th, 1926. (271,094.)
12,884. "Means for producing modulated electric carrier currents." E. H. Robinson. May 13th, 1927. (295,437.)
12,934. "Magnetic alloys." W. S. Smith, H. J. Garnett, and J. A. Holden. May 13th, 1927. (295,443.)
12,941. "Electromagnetic relays." Associated Telephone and Telegraph Co. June 21st, 1926. (272,872.)
12,945. "High resistances and processes for the manufacture thereof." T. D. Parkin. May 13th, 1927. (295,444.)
12,979. "Composition of matter for magnetic screening and other purposes." W. Dunbar. May 14th, 1927. (295,613.)
12,989. "Electric protective systems." British Thomson-Houston Co., Ltd., H. S. Petch, and J. G. Wellings. May 14th, 1927. (Addition to 213,941.) (295,614.)
13,121. "Thermomagnetically-operated devices." Automatic Telephone Manufacturing Co., Ltd., and P. N. Roseby. May 16th, 1927. (295,667.)
13,165. "Telephone receivers." Standard Telephones & Cables, Ltd., and S. T. Buer. May 17th, 1927. (295,668.)
13,166. "Arrangement for coupling carrier-wave signalling apparatus to a transmission line." Standard Telephones & Cables, Ltd. (Western Electric Co., Inc.). May 17th, 1927. (295,669.)
13,347. "Single-phase electromagnets." A. Reyrolle & Co., Ltd., and N. Cooke. May 18th, 1927. (295,739.)
13,364. "Devices for the preventing of dazzle in incandescent electric lamps." P. W. Sherrin and H. C. Goodridge. May 18th, 1927. (295,740.)
13,375. "Galvanic batteries." A. M. Codd. May 18th, 1927. (295,743.)
13,485. "Electric switchgear." A. Reyrolle & Co., Ltd., R. Anderson, and H. W. Clothier. May 19th, 1927. (295,749.)
13,568. "Telephone transmitters." Standard Telephones & Cables, Ltd., L. C. Pocock, and C. B. V. Neilson. May 20th, 1927. (Addition to 186,896.) (295,751.)
13,593. "Telephone handsets." Automatic Telephone Manufacturing Co., Ltd., and S. R. Smith. May 20th, 1927. (295,752.)
13,735. "Electric fires, electric radiators, and the like." Credenda Conduits Co., Ltd., and P. W. Davis. May 23rd, 1927. (295,745.)
13,839. "Wireless telegraphic and like apparatus." G. W. Croot. May 23rd, 1927. (295,763.)
13,857. "Electric switches." H. Garde. May 23rd, 1927. (295,764.)
13,858. "Electric lampholders." H. Garde. May 23rd, 1927. (295,765.)
14,302. "Systems of electric generator control." British Thomson-Houston Co., Ltd., J. V. Peacock, and L. R. Nixon. May 27th, 1927. (295,772.)
14,342. "Miners' and other electric safety-lamps." A. G. Gulliford and W. Maurice. May 27th, 1927. (295,773.)
14,513. "Driving aggregate for use in connection with self-propelled electric vehicles." M. Gelinek. May 30th, 1927. (295,777.)
14,615. "Electric winding mechanism for clocks." R. C. Grasseby. May 31st, 1927. (295,780.)
15,539. "Combination of musical instruments electrically operated by means of keyboard and pedals." A. Barbieri. June 10th, 1927. (295,468.)
16,009. "Holders for electric lamps." A. Kirk. June 16th, 1927. (295,471.)
16,164. "Impulse starters for magneto-electric machines." British Thomson-Houston Co., Ltd., J. H. Pollard, and E. G. Parrott. June 17th, 1927. (295,473.)
16,512. "Speed-reducing devices for control with automatic two-speed reduction, more particularly applicable to radio apparatus (condensers, variometers, and the like)." A. Bonnefont. August 17th, 1926. (Addition to 269,211.) (276,308.)
18,006. "Electric switches." Wilkins & Wright, Ltd., and J. H. Hewitt. July 7th, 1927. (295,484.)
18,912. "Tuning device for measuring and controlling instruments, preferably in broadcasting apparatus." J. Berglin. July 16th, 1926. (274,498.)
19,051. "Electric pendulum make-and-break device." Dr. S. Loewe. July 19th, 1926. (274,506.)
19,053. "Electric rectifiers for supplying amplifying sets used in wireless telephony or telegraphy receiving apparatus." Dr. S. Loewe. July 19th, 1926 (274,508.)
19,104. "Electric couplings." A. C. Wynne. July 19th, 1927. (295,495.)
19,291. "Apparatus for reproducing sound." Electrical Improvements, Ltd., and L. C. Grant. July 20th, 1927. (295,498.)
19,384. "Supply of current to radio apparatus." Igranic Electric Co., Ltd., S. R. Wright, and L. E. Currah. July 21st, 1927. (295,501.)
19,408. "Enclosures for electric transformers." English Electric Co., Ltd., and A. T. Chadwick. July 21st, 1927. (295,502.)
22,475. "Manufacture and production of electrodes, welding-rods, and the like, for use in welding and depositing metal." B. Turner and Ferro-Arc Welding Co., Ltd. August 26th, 1927. (295,514.)
23,020. "Galvanic batteries." Oldham & Son, Ltd., and W. D. Wilde. September 1st, 1927. (Cognate application 24,140/27.) (295,516.)
26,924. "Control of electric power." British Thomson-Houston Co., Ltd. October 16th, 1926. (279,080.)

1928.

1,438. "Therapeutic lamps." A. K. Croad (Hanovia Chemical & Mnfg. Co.). January 16th, 1928. (295,897.)
2,301. "Metal plating." British Thomson-Houston Co., Ltd. January 27th, 1927. (284,302.)
2,570. "Means for influencing a train from the line, or conversely." Siemens & Halske Akt. Ges. July 30th, 1927. (294,870.)
2,954. "Illuminated instrument panels." A. C. Spark Plug Co. February 28th, 1927. (286,218.)
3,075. "Electro-optical devices for use in picture transmission, sound films, and for other purposes." Telefunken Ges. für Drahtlose Telegraphie. February 23rd, 1927. (285,850.)
3,085. "Electromagnetic means for operating the brake lever of an electric winch, windlass, or the like." Sunderland Forge and Engineering Co., Ltd., and W. B. Marr. January 31st, 1928. (295,552.)
3,416. "Bearing bracket for small electric dynamos." R. Bosch Akt. Ges. February 3rd, 1927. (284,673.)
4,128. "Vacuum electric tube devices." E. Y. Robinson and Metropolitan-Vickers Electrical Co., Ltd. August 5th, 1927. (Divided application on 285,537.) (295,904.)
4,309/4,315. "Telephone systems." Standard Telephones & Cables, Ltd., E. P. G. Wright, J. H. E. Baker, and A. H. Cameron. May 10th, 1927. (Divided applications on 295,421.) (295,445/295,451.)
4,493. "Manufacture of accumulator plates." I. G. Farbenindustrie Akt. Ges. February 12th, 1927. (Addition to 284,352.) (285,354.)
5,483. "Aerial insulators." Dr. G. Seibt (trading as Dr. G. Seibt Fabrik Elektrischer Apparat) and A. Salomon. May 14th, 1927. (290,561.)
8,384. "Accumulator contact plates." Concordia Elektrizitäts Akt. Ges. and W. Gosmann. March 19th, 1928. (295,561.)
8,465. "Electric arc or other fusion welding." British Thomson-Houston Co., Ltd. March 23rd, 1927. (287,538.)
9,066. "Arc-lights." Korting & Mathiesen Akt. Ges. March 29th, 1927. (287,905.)
9,697. "Electrical regulating systems." Metropolitan-Vickers Electrical Co., Ltd. April 2nd, 1927. (288,181.)
9,698. "Electric switches for transmission lines." Metropolitan-Vickers Electrical Co., Ltd. April 2nd, 1927. (288,182.)
9,783. "Power plant installations employing electric generators." Metropolitan-Vickers Electrical Co., Ltd. March 31st, 1927. (288,165.)
10,190. "Electric heating devices." H. G. C. Fairweather (Wilcolator Co.). February 7th, 1927. (Divided application on 292,192.) (295,310.)
10,391. "Radio and the like high-frequency apparatus." Telefunken Ges. für Drahtlose Telegraphie. April 14th, 1927. (288,634.)
10,770. "Electrical signal transmission systems." Lovejoy Development Corporation. April 15th, 1927. (288,636.)
12,390. "Electric clocks operated by dry batteries." F. M. Busse. April 29th, 1927. (289,479.)
12,961. "Submarine cables." Felten & Guilleaume Carlswerk Akt. Ges. September 16th, 1927. (295,923.)
13,803. "Coating wires and the like." International General Electric Co., Inc. May 11th, 1927. (290,252.)
14,031. "Operation of space-discharge devices suitable for wireless signalling." British Thomson-Houston Co., Ltd. May 13th, 1927. (290,302.)
15,133. "High-frequency signal amplification systems." British Thomson-Houston Co., Ltd. May 23rd, 1927. (291,014.)
15,651. "Thermionic valve amplifying or detecting systems." British Thomson-Houston Co., Ltd. June 1st, 1927. (291,405.)
16,574. "Methods of assembling electrical apparatus." British Thomson-Houston Co., Ltd. July 1st, 1927. (293,024.)
17,757. "Imitation fires." Automatic Telephone Manufacturing Co., Ltd., and R. N. Roseby. May 16th, 1927. (Divided application on 295,667.) (295,674.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from August 29th:—

Alugine. No. 492,846. Class 5. Unwrought or partly wrought metals and metallic alloys—La Société d'Electrochimie, d'Electrométallurgie et des Aciéries Electriques d'Ugine, Paris. (British representatives: Carpmael and Ransford, 24, Southampton Buildings, Chancery Lane, W.C.2.)
Magnavisor. No. 490,076. All goods in Class 8—Radiovisor, Ltd., 26, Church Street, Cambridge Circus, W.C.1.
Milletone. No. 492,705. All goods in Class 8.—Millett's Stores (1928), Ltd., 83-85, Granby Street, Leicester.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ATHERTON.—Housing scheme (44), Hag Fold Estate (deposit £2 2s.); surveyor to U.D.C.

AIREDALE.—Church (£4,000), for the Wesleyan trustees; Garside & Pennington, architects, Pontefract.

AMERSHAM.—Housing scheme (22), for the R.D.C.; surveyor.

ASHFORD.—Two schools (700 places), for Kent E.C.; E. Salter Davies, director of education, Sessions House, Maidstone.

AYLESHAM (KENT).—Houses (100), for Eastry R.D.C.; Lewis and Sons, builders, Dover.

BECCLES.—School extension (£4,000); East Suffolk Education Committee.

BEXLEY.—Two schools (700 places), for Kent E.C.; E. Salter Davies, director of education, Sessions House, Maidstone.

BINLEY.—Infants school; Warwickshire Education Committee.

BLACON (CHESTER).—Church, Holy Trinity parish; Rev. P. A. W. Skinner, rector.

BOSTON.—Electric light installation, infirmary and chapel, for the B.G.; clerk.

BRADFORD.—Erection of six houses and shops on Housing Scheme No. 6, Eccleshill; N. L. Fleming, Town Clerk, Town Hall, Bradford.

BRENTFORD.—Elementary school; Brentford and Chiswick Education Committee.

BURNLEY.—Additional 64 houses, Stoops Estate, for the T.C.; borough surveyor.

CAMBRIDGE.—Bottling stores for Dale's Brewery; George Adlam & Sons, Ltd., architects, Bristol; A. E. Brown and Co., builders, Grantham.

CARLTON COLVILLE.—Smallpox hospital; East Suffolk medical officer.

CHELMSFORD.—Development, Moulsham Estate; Mr. R. H. Currie.

CHORLEY.—Conversion of Rookwood into hospital; Berry and Sons. Extensions, Weldbank Institute; Rev. Father Bilsborrow. Additions, Bleach Works, Common Bank; Chorley Bleaching Co.

CRAYFORD.—Housing scheme (131), for the U.D.C.; Frank Leary, surveyor (returnable deposit of £3 3s.).

DOVER.—Business stores, Biggin Street, and machine dairy, Maison Dieu Road, for the River Co-operative Society; Co-operative Wholesale Society architect, Balloon Street, Manchester.

DURRINGTON.—Special subjects centre, for Wilts. E.C.; T. Walker, county architect, Trowbridge (returnable deposit of £1 1s.).

ELSTREE (HERTS.).—Garden city, Boreham Wood, with all-electric houses, for the Housing Corporation of Great Britain; A. L. Thomas and Douglas Wood, architects, Craven Street, London.

EXETER.—Housing scheme (428), for the T.C.; city surveyor.

FALKIRK.—Sausage factory (£3,500) for Falkirk and District United Co-operative Society, Ltd., 200, Graham's Road; Alex. Drummond, secretary.

FARMOOR.—School; Berks. Education Committee.

FELIXSTOWE.—Secondary school; East Suffolk Education Committee.

FIFE.—Addition to Elie Public School; Mr. George Sandilands, architect, Fife Education Offices, Kirkcaldy.

GLASGOW.—Extension to factory for Cooper, McDougall and Robertson, Ltd., Kelvindale Works, Maryhill; the manager. Shops at Littlehill Street for Corporation Housing Department; the director of housing.

HALESOWEN.—School for Worcestershire E.C.; A. T. Butler, architect, Dudley.

HALVERGATE.—Elementary school; Norfolk Education Committee.

HATFIELD.—School, Newtown (£7,800), for Herts. E.C.; director of education, Hertford. Offices for the R.D.C.; P. C. Blow, architect, St. Albans.

HESTON.—Secondary school; Middlesex Education Committee.

HULL.—Estate development off Southcotes Lane; Alexandra Land Co. and Yorkshire Estate Co.

HUYTON.—Elementary school; Lancashire Education Committee.

IPSWICH.—Police station; East Suffolk Standing Joint Committee.

IRLAM.—Police station (£8,250); Lancs. Standing Joint Committee.

KENTON.—Elementary school, Kenton Road; Middlesex Education Committee.

LITTLEHAMPTON.—Housing scheme (20), for the U.D.C.; L. G. Dashper, surveyor.

LLAY (WREXHAM).—Pit head baths (£20,000), for the Llay Main Colliery Co., Ltd.; S. Gill, managing director.

LONDON (CRICKLEWOOD, N.W.).—Iron foundry, Edgware Road; Imperial Machine Co.

(KENSAL GREEN, N.W.).—Forty-four houses, Kensal Rise; Geo. Ball (Willesden), Ltd.

(WILLESDEN, N.W.).—Factory extension, Park Royal; Milk Trade Supplies, Ltd. Additions, Church Road, for North London Engineering Co.; H. Shaw. Wagon shed and miniature range, Pound Lane; S. W. Cranfield, for Middlesex Territorial Army Association. Joinery works, stores, &c., Oxgate Lane; E. Howard & Partners. Development, Brentwater Estate, for Walton Heath Land Co., Ltd.; W. Peachey.

(CHARLTON, S.E.).—Catholic schools (£8,000 to £10,000); Walters & Sons, architects, Great Ormond Street; E. G. Bradford, builder, Leicester.

(LAMBETH).—Buildings site of 133-183, Waterloo Road; Payne, Wyatt, Son & Partner.

(CHELSEA).—Development scheme off Cheyne Walk; Sir Regd. Blomfield, 1, New Court, Temple.

(STOCKWELL).—Buildings, Ferndale Road; Southern Railway Co.

(WANDSWORTH).—Rebuilding 283-291, Wandsworth Road; Royal Arsenal Co-op. Society, Ltd. Buildings, 74-84, Wandsworth Road, and Pascal Street; Trollope & Colls, Ltd.

LOUTH.—General Post Office, for H.M. Office of Works, King Charles Street, London, S.W.

MANSFIELD.—Housing scheme (53), for the T.C.; W. Thompson, borough engineer (returnable deposit of £2 2s.).

MOSSLEY (LANCS.).—Housing scheme (22), for the T.C., by direct labour; borough surveyor.

NEWCASTLE.—173 houses, Walker Estate; Mr. A. V. Clery.

NORTH WALSHAM.—Cookery and art rooms, High School; Norfolk Education Committee.

NORTHWICH.—Estate development, Waverham; Greenall, Whitley & Co.

PETERBOROUGH.—Children's cottage home, for the B.G.; S. Dodson, architect, 15, Queen Street (returnable deposit of £1 1s.).

PONDERS END.—Extensions, Technical College; Middlesex Education Committee.

RAINWORTH (NOTTS.).—Billiard hall, for Mr. Kitchener.

RUSWARP (WHITBY).—Electric light installation, parish church, for the church wardens; vicar.

SANDWICH.—Housing scheme (26), for the T.C.; W. B. Moultrie, acting borough surveyor, The Barbican (returnable deposit of £2).

SOUTHPORT.—Maternity hospital; Miss Christina Hartley, J.P., donor.

SWAFFHAM PRIORS (NEWMARKET).—Church day schools, for the managers; G. P. Banyard, architect, 4, Market Street, Cambridge.

WARDLE.—Elementary school; Lancashire Education Committee.

WEMBLEY.—Extensions, Glass Works, East Lane; General Electric Co. Thirty-four houses, London Road; A. Nimmo. Twenty-two houses, Dovedale Avenue, &c.; F. Costin, Ltd. Alterations, old welfare building, B.E.E.; Metropolitan Railway Co.